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A NEW ELECTRIC SMELTING FURNACE.

FINANCING IRRIGATION AND POWER DEVELOPMENT.

BY JNO. H. LEWIS.

SAFETY REGULATIONS FOR ELECTRIC POWER COMPANIES.

BY W. K. FREUDENBERGER.

MITIGATION OF ELECTROLYSIS.

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Alphabetical Index to Advertisers, Page 8 Where to Buy It in the West, Page 9

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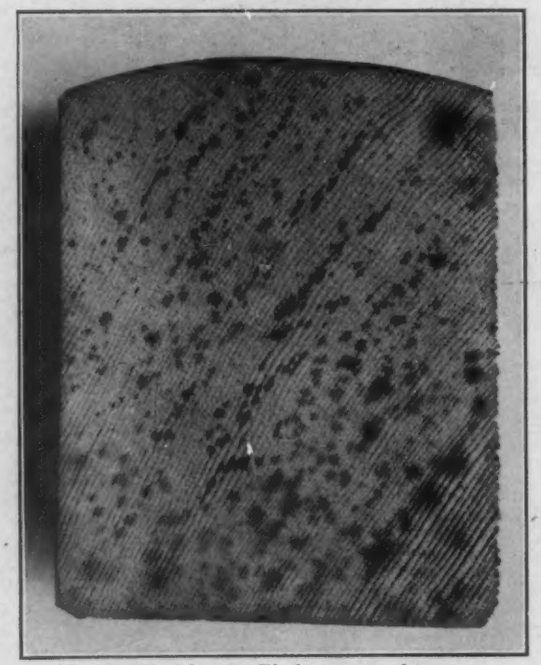

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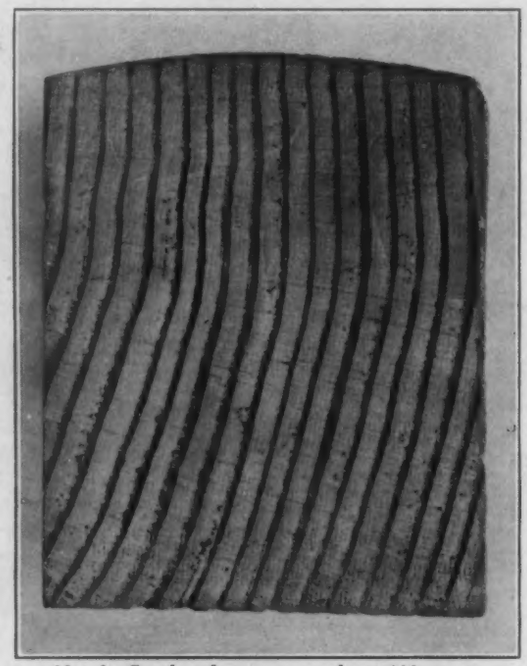

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FINANCING IRRIGATION AND POWER DEVELOPMENT

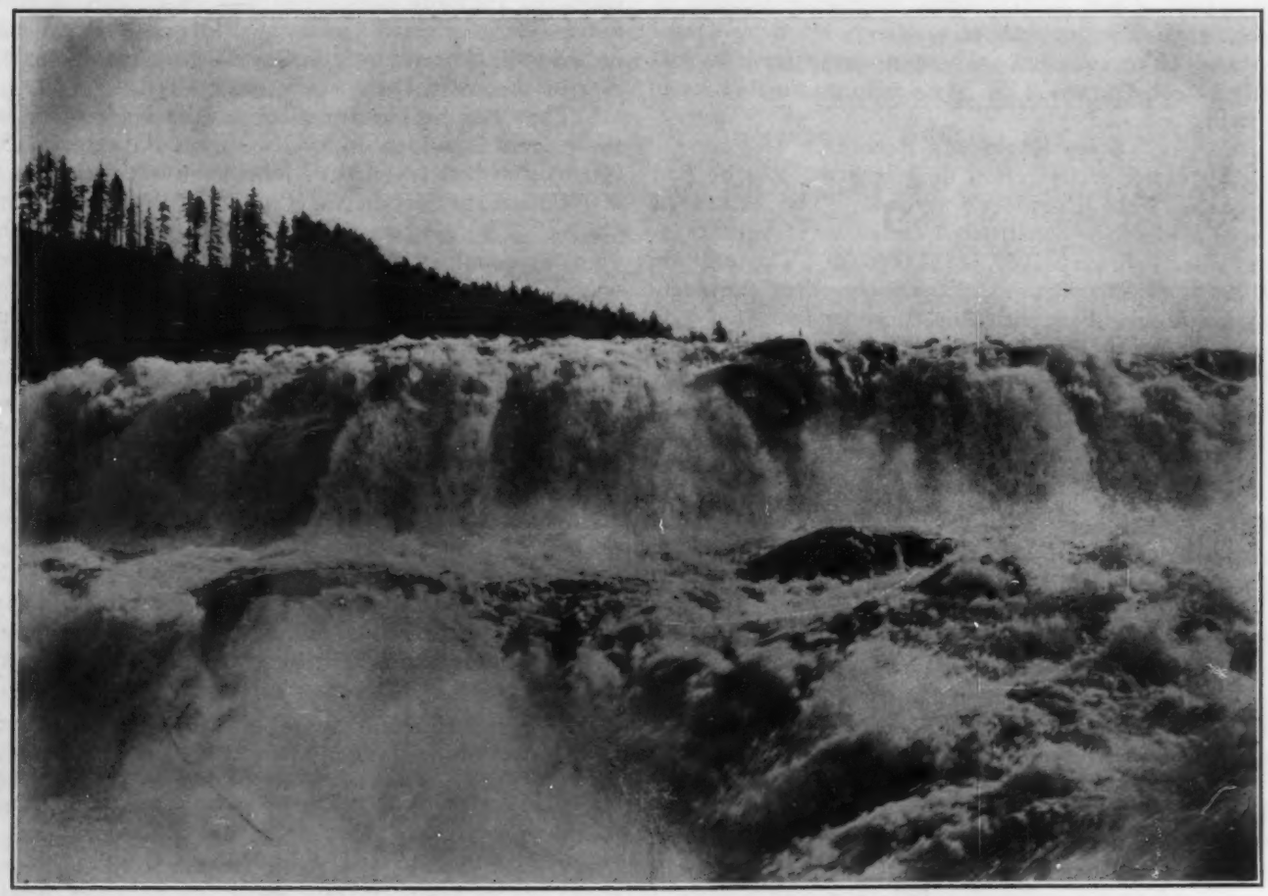
BY JOHN H. LEWIS.

(This brief, though comprehensive summary of irrigation and hydroelectric power possible and developed in the Pacific Northwest, was presented by Mr. Lewis, who is State Engineer for Oregon, at the Regional Bank Hearing held recently at Portland, Oregon.—The Editors.)

We have in the Columbia River basin and tributary to Portland, 2,450,000 acres of land which have been irrigated at a cost of $70,000,000 or approximately $30 per acre. This cost will be increased to $120,000,000 when all of the projects are completed which were under way at the time the U. S. Census was taken.

Between 1900 and 1910, the irrigated acreage in Oregon, Washington and Idaho shows an increase of 120 per cent and the cost of contracted works increased over 700 per cent. If this rate of increase continues the next census will show that $500,000,000 will have been invested in irrigation projects during this decade. Portland is the logical industrial and financial center for this rapidly developing territory.

The highest dam in the world is now being constructed by the United States on the Payette-Boise project in the upper Snake River valley. The project now has a population of 75,000 people. It will ultimately cost $15,000,000 and irrigate 348,000 acres. Plans for the construction of a number of large projects have been worked out for Idaho, Washington and Oregon, and construction will proceeded as soon as some plan for financing is matured. One of the



Water Power Favors Industrial Development of the Pacific Northwest.

largest is the Bruneau Project in Idaho, involving the reclamation of 636,000 acres at an estimated cost of $25,000,000.

Irrigation in Oregon.

In Oregon we have 686,000 acres of irrigated land and a water supply available for the reclamation of 4,000,000 acres in all. One-half of this area is in large projects which have been the subject of engineering investigations and which can be irrigated at a cost of $40 to $60 per acre.

Plans for a definite state-wide irrigation program are well under way. At the last session of the legislature $450,000 was appropriated for the completion of the 23,000 acre Tumalo Project in the Deschutes River Valley. Work is now under way. The Secretary of the Interior has agreed to contribute an equal amount for construction work in this basin.

At the same time $50,000 was appropriated for the preparation of plans and estimates of cost for the construction of various large projects throughout the state. This work is being carried on in co-operation with the Secretary of the Interior, who has contributed an equal amount. Already the field work on a 200,000 acre project in the Deschutes valley has been completed and this summer the John Day-Umatilla project of about 100,000 acres will be examined as well as smaller projects in Malheur, Harney, Klamath and Lake counties. These projects must eventually be constructed if our state is to attain its proper growth.

State Engineer's Records.

An index of irrigation development may be had from the State Engineer's records. The estimated cost of works to be constructed under water permits issued since February, 1909, is $51,000,000. The total for 1913 was $7,000,000, or $3,000,000 less than the average for previous years. This decrease indicates that fewer large projects have been undertaken, but otherwise shows a healthy development as a larger number of permits were issued during 1913 than the average for previous years.

Waterpower.

Twenty million horsepower or approximately one-third of all the undeveloped waterpower in the United States is located in the Columbia River basin. Of this amount, over 3,000,000 horsepower is found in streams within easy transmission distance of the city of Portland.

We thus have more undeveloped waterpower in the Columbia River basin, tributary to Portland, than the total which is now generated by various means and used in manufacturing industries throughout the United States, according to the recent census. Only 516,000 h.p. is utilized in the various industries in Oregon, Washington and Idaho.

The development and use of this resource will mean much to the navigation, irrigation and industrial development of the great inland empire.

It is only the past few years that any possible market for this power could be seen. With the invention and the phenomenal development of the electric furnace, a new era in the industrial development of the west is rapidly dawning.

It can be demonstrated that with cheap electric power, iron and steel can be produced in the vicinity of Portland at a cost comparing favorably with Pittsburgh; that iron ore can be had from China cheaper than it can be secured in Chicago; that the capital cost of an electric iron and steel plant is about one-third that for the ordinary fuel plant; also that electric steel is superior for railway rails, steel castings and tool steel.

With the development of this power and the resulting canalization of our rivers, the extensive iron, copper, lime, timber and other resources of the interior basin can be brought to Portland where lumber and other facilities may be found superior for the manufacture and marketing of such raw products.

The Columbia River basin is destined to compete successfully with the natural nitrate fertilizer industry of Chile, as enough nitrogen is found in the air, over one square mile of the earth's surface to supply the world for 50 years. To produce from the air, the nitrate fertilizer now used by the civilized world will require the investment of $860,000,000 in waterpower plants.

In addition there are many other electric furnace and electro-chemical industries where the cost of power is one of the leading items in the cost of production. Portland is destined to secure many of such industries which are seeking world markets. It will in time be known as the smokeless manufacturing city of the west.

That the people are alive to the importance of these facts is evidenced by the appropriation of $15,000 by the last legislature for the investigation of a 300,000 h.p. project in the Columbia River near The Dalles. The Secretary of the Interior has contributed an equal amount and joint work is now under way. A preliminary report indicates that power can be furnished in the vicinity of such plant for about $7 per horsepower year in comparison with $50 to $450 the usual commercial rates for varying quantities.

The object of this joint investigation is to secure definite information as to the cost of developing and transmitting this power to various points in Oregon and Washington as a basis for the adoption of some comprehensive waterpower policy which will lead to the rapid development of this resource, in the public interest. A constitutional amendment authorizing the issuance of state bonds for the construction of waterpower plants will be voted upon by the people of Oregon in November of this year.

The experimental stage of the electric furnace being over at this time, when the Panama Canal is opening the way for world commerce, it is clear that the industrial development of the Northwest will be rapid. To conduct our present business, which compares most favorably with other points in the territory, and to facilitate this rapid development which is sure to come, convenient banking and credit facilities are essential. Portland, located at the crossroads for north and south traffic, and at the point where many of the products of the great inland empire must be transferred to ocean carriers for world markets, is the logical banking centre for this territory.

EFFECT OF FORESTS ON RUNOFF.

BY J. C. STEVENS.

(Continued.)

Analyses of the Tennessee records such as that referred to, have been made by Prof. Willis L. Moore, Chief of the U. S. Weather Bureau, and M. O. Leighton, of the U. S. Geological Survey. Each arrives at radically different conclusions by using the records since 1883. Evidently this is too short a period from which to drawn conclusions. I shall later present some data of this kind in connection with the records of the Merrimac River.

Ohio River Basin.

The records of precipitation on this watershed begin in 1830, and the records of gauge readings at Cincinnati begin in 1858. The discharge data has been compiled by the United States Army Engineers and by the United States Geological Survey. Gauge records are found in publications of the army engineers and those of the Weather Bureau.

The extent of deforestation is unknown, but has been considerable. This river has also been held up by forestry advocates as an example of the injurious effects of deforestation. For that reason the records are of double interest.

The following table presents the data in similar fashion as for the Tennessee River, except that the total interval of 78 years for precipitation data is divided into eight periods, and the 50 years of precipitation and runoff records into five periods.

Ohio River at Cincinnati, Ohio.
(Drainage Area, 73,900 Square Miles.)

Period.	Precipitation. (inches)	Runoff. (inches)	Runoff per in. of precipitation. (inches)	Maximum discharge. (sec. ft.)	Minimum discharge. (sec. ft.)	Uniformity. Ratio
1st 8 years—1830-1837..	39.2					
2d 10 years—1838-1847..	40.0					
3d 10 years—1848-1857..	41.8					
4th 10 years—1858-1867..	43.8	17.0	.39	419,000	10,150	.024
5th 10 years—1868-1877..	40.3	15.8	.39	407,100	10.720	.026
6th 10 years—1878-1887..	41.7	19.0	.45	476.400	8,900	.019
7th 10 years—1888-1897..	41.3	17.0	.41	405,500	10,510	.026
8th 10 years—1898-1907..	39.7	16.7	.42	462,900	11,000	.024

Fig. 2 shows the hydrographs and the period averages in a manner similar to those for Tennessee River. The runoff per inch of precipitation has apparently increased coincident with a reduction in forest cover, which is directly opposed to the forestry theory, since this region is classed as humid. Now if this was also accompanied by a decrease in the uniformity of flow, our forestry friends might even yet find comfort in the records. But such is not the case. The lowest uniformity coincides with the period of greatest runoff, in the sixth period. An examination of the hydrograph will show high precipitation and high floods in 1882-3-4. Now if this is due to removal of forests, why were not the years 1890-1 also noted for high floods? Surely there was less forest area in 1890 than in 1882. The reason lies in the intensity and nature of precipitation, and not in the slightest degree in forestry influences. The general parallelism of the precipitation and runoff curves indicate that the former is the first, last and only cause of the latter. The amount of the one in the main govern the amount of the other, while variations in the nature and intensity of the one are reflected in variations in the runoff per inch of precipitation. The vegetation on the ground surface has too small an influence to be detected.

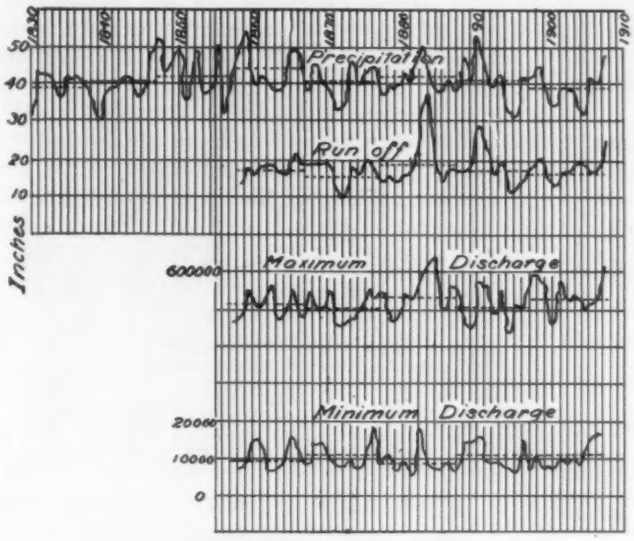


Fig. 2. Ohio River Chart.

Ottawa River Basin, Canada.

In connection with the proposed Georgian Bay Ship Canal, the Department of Public Works, Canada, has compiled the discharge of Ottawa River above Besserer's Grove (nine miles below Ottawa) from 1850 to date, and the precipitation on the watershed from 1866 to date. (Georgian Bay Ship Canal Report for 1908, Plates 30 and 56; also Progress Report 1909-1910, p. 41.)

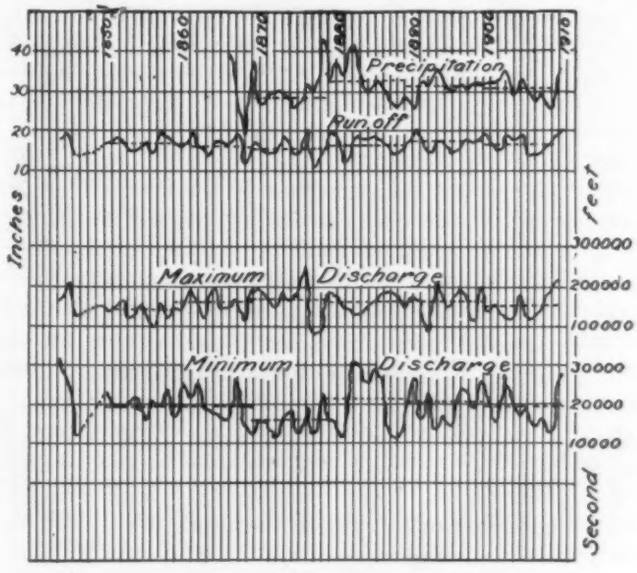


Fig. 3. Ottawa River Chart.

No detailed estimate of the amount of deforestation that has taken place on this watershed has as yet been made, except that it is known to be considerable. At one time the entire watershed was heavily forested with spruce, pine, etc. Lumbering

operations have been carried on extensively for the past 30 years at an increasing rate. The river valleys in the lower reaches have for the most part been cleared for agricultural purposes, yet the percentage of reduction of forests on this watershed is not great, but may be taken at about 10 per cent during the period of record.

The total drainage area above the gauge is 45,500 square miles. There are numerous lakes on the watershed, some of them being of large extent. A large part of the precipitation is in the form of snow, and the spring thaws cause annual rises of varying magnitude. They nearly always reach a maximum in May.

The treatment is similar to that followed for Tennessee and Ohio Rivers.

Ottawa River at Besserer's Grove.
Drainage Area, 45,500 Square Miles.

Period.	Precipitation. (inches)	Runoff. (inches)	Runoff per in. of precipitation. (inches)	Maximum discharge. (sec. ft.)	Minimum discharge. (sec. ft.)	Uniformity. Ratio
1st 10 years—1850-1859..		16.72		144,300	19,900	.138
2d 10 years—1860-1869..		16.38		161,000	19,700	.122
3d 10 years—1870-1879..	28.58	15.80	.55	168,000	16,100	.096
4th 10 years—1880-1889..	32.71	16.50	.50	165,800	21,200	.128
5th 10 years—1890-1899..	31.71	17.12	.54	166,700	20,500	.123
6th 10 years—1900-1909..	31.13	16.78	.54	153,000	19,200	.125

In Fig. 3 are shown the corresponding hydrographs.

The high uniformity of flow in this stream, compared with those heretofore considered, is accounted for by the large percentage of lake surface on its area. These are the true equalizers of the flow, and not the forests. The lowest uniformity is coincident with a period of highest precipitation, viz: 1878 to 1882, and certainly this was before any material reduction in forest cover had occurred. The fourth period, however, shows the highest uniformity (except the first) and this must not be given too much weight because of the inaccuracies of the earlier records. The whole record shows no change either in total runoff or in uniformity of flow that can in any degree be attributed to the removal of forests. In fact, the reduction of forest cover on this stream is comparatively slight. The headwaters are still covered with virgin forests.

Murray River Basin, Victoria, Australia.

On this watershed progressive deforestation has taken place during the past 25 years. Climatically, the country is semi arid. The waters of the stream are extensively used for irrigation, by both gravity and pumping systems. On this account it will not be admissible to use minimum discharge, nor the total annual yield, since this quantity is more or less under artificial control. The flood discharges however, can be safely used in a study of this nature. The official records, compiled under the direction of Stuard Murray, M. Inst. C. E. Chief Engineer of the Rivers and Water Supply Commission of the State of Victoria, have been used.

The practice of rink-barking (to kill) the trees on large areas in this region has been in force for many years. Some American Engineers (Engineering News, October 1, 1908. Proceedings of Annual Convention New England Water Works Association) personally familiar with the practice, state that it is extremely common in Australia and has been done to increase the stream flow. Dr. Elwood Mead, the present Chief Engineer of the Water Supply Commission, in a letter to me (Feb. 11, 1911), states that the real reason is to "improve the pasturage." The live trees shade the ground and draw sustenance from it and thus reduce the growth of grass.

It is impossible to ascertain in detail the amount of deforestation during the period of record, but it is known to be quite extensive.

Murray River at Mildura, Victoria.

Period.	Mean annual Discharge, (sec. ft.)	Average Maximum Discharge, (sec. ft.)
1st 20 years—1865-1885	11,800	28,900
2d 20 years—1886-1905	11,150	26,500
Change in 2d period..	6 per cent decrease.	9 per cent decrease.

The decrease in mean discharge had undoubtedly been due both to decreased preciptation and to diversions above the gauge. The records of precipitation do not begin until 1883, and this is too short a period from which to draw conclusions. The significant truth in the above table is that the flood heights have decreased during the period of record coincident with the removal of forests, instead of increasing as the forestry theory teaches. This, however, cannot be attributed to the removal of forests, but is due to variations in the amount and intensity of rainfall during the two periods and doubtless to regulation resulting from the construction of storage reservoirs in the watershed for irrigation purposes.

Merrimac River Basin.

Lieut. Col, Edw. Burr, U. S. Army Engineers, has made an exhaustive report on "an investigation of the influence of forests on the runoff in the Merrimac Basin," (House Document No. 9, 62d Congress, 1st Session, "Merrimac River, Mass., Between Haverhill and Lowell") from which the descriptions and data are taken. The latter have been arranged to conform to the manner of representation adopted for this report. We have the analysis of precipitation and of total yield and uniformity, and in addition are able to present data on the variations of moderate freshets or medium floods.

The Basin of Merrimac River lies both in New Hampshire and in Massachusetts. The headwaters are in the rugged White mountain region, and the middle and lower valleys are rolling country with some areas of lake surface and small swamps.

The underlying rock is gneiss and granite. Over these lie glacial drift of sand, gravel and boulders, frequently mixed with finer materials, and covered in the valleys with alluvium clays and other soils brought down from higher elevations. A large portion of the valley lands are, or have been agricultural, while the uplands are unfit for any growth except forests on account of the great masses of boulders and other glacial debris that cover the surface.

Originally the entire area was in forest. When the Pilgrims arrived in New England "they were much comforted, especially seeing so goodly a land and

wooded to the brink of the sea." As population increased deforestation of the land steadily progressed to secure agricultural land and to supply commercial lumber. After a time, owing to western competition, a decline in both lumbering and agriculture set in and large areas that were once tilled are now grown up to brush and timber, some of the timber being already of commercial size. These facts are well known, but the author of the above mentioned report had instituted a very careful study of the statistical data, and expresses his conclusions thus:

Deforestation (of Merrimac River Basin) continued progressively from the earliest settlements to about 1860-1870; reforestation through natural processes has progressed since 1870 at a rate which has increased from 1880 to 1900 or later; and the forest areas are larger now than in 1860-1870 by as much as 25 to 30 per cent of the entire basin. [4]

In New Hampshire, which is practically representative of the Merrimac Basin, the forest area has changed as follows:

Forest Area in New Hampshire.[4]

	Percentage of State	Percentage change.
1850	45.1	.....
1860	43.1	2.0 decrease
1870	43.1	0.6 increase
1880	46.0	2.3 increase
1890	59.1	13.1 increase
1900	67.4	8.3 increase

The discharge and runoff data have been compiled from gauge records kept by the Essex Company below its dam at Lawrence, Mass, since 1849. Discharges computed over the dam and through the wheels and mill-races of the company and by actual discharge measurements since 1888, serve to translate these gauge heights into mean daily discharges, from which the runoff has been computed.

The precipitation data are taken from reports of the U. S. Water Bureau and from records kept by the power companies along Merrimac River.

The following table gives similar data to those presented for the other basins discussed.

Merrimac River at Lawrence, Mass.
(Drainage Area, 4660 Square Miles.)

Period.	Precipitation. (inches)	Runoff. (inches)	Runoff per in. of precipitation. (inches)	Maximum discharge. (inches)	Minimum discharge. (inches)	Uniformity. Ratio
1st 9 years—1850-1858.	.....	24.60	.....	47,800	2,160	.045
2d 10 years—1859-1868.	41.20	23.21	.563	42,900	2,430	.057
3d 10 years—1869-1878.	40.88	22.94	.562	46,400	2,500	.054
4th 10 years—1879-1888.	40.91	21.70	.530	34,100	2,340	.069
5th 10 years—1889-1898.	41.99	22.15	.528	40,600	2,270	.056
6th 10 years—1899-1908.	40.04	21.90	.547	43,100	2,190	.051

In Fig. 4 are shown the hydrographs for this stream.

Again the direct relation between precipitation and runoff is apparent from the general parallelism of these two curves. The total runoff per inch of precipitation shows a slight decreasing tendency coincident with an increase in forest cover. This is opposed to the forestry theory and substantiates the belief that forests use large quantities of water, and hence always reduce the runoff. However, it is much more reasonable to believe that these changes are due to variations in precipitation and have occurred entirely independent of the forests. The uniformity ratio is seen to be highest when the forest area was least, in the fourth period, but the hydrographs show this to be a period of low rainfall, which readily accounts for it. The uniformity of flow on this stream has not sensibly changed during the period of record. The slight variations must be attributed to the precipitation and not to forests.

4 Ibid p. 15

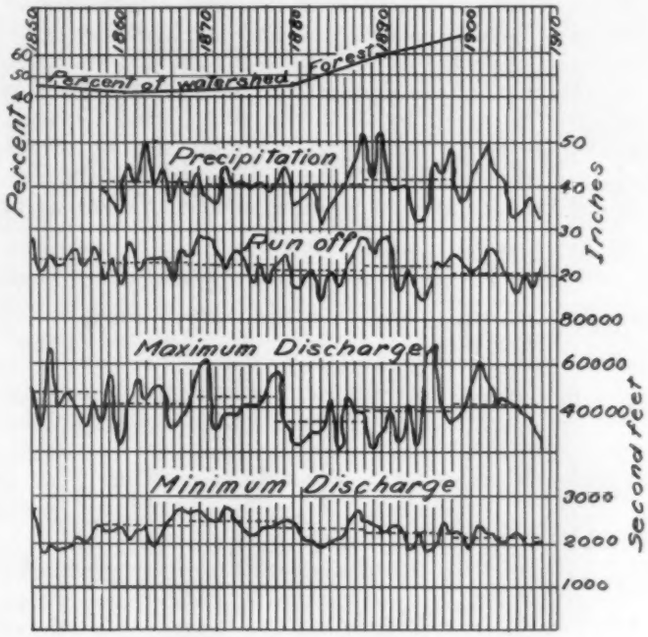


Fig. 4.—Merrimac River (at Lawrence, Mass), Chart.

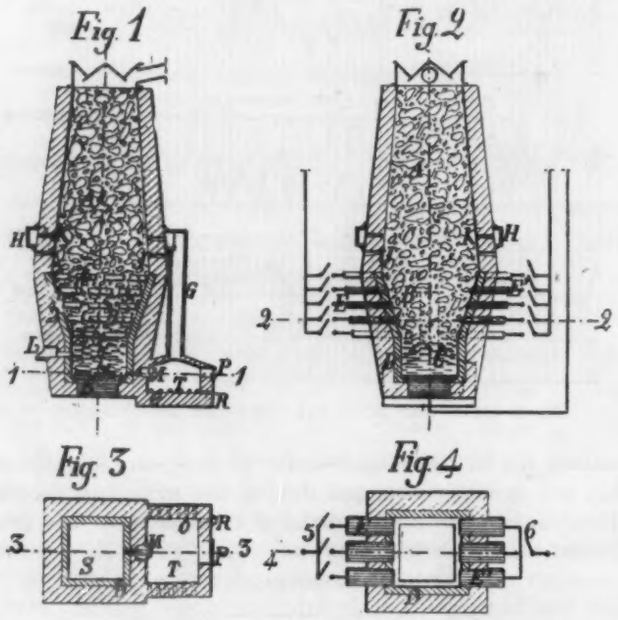
(To be continued.)

The resistance of the soil varies greatly with temperature within the ordinary range encountered in practice. Even at about freezing temperatures the resistance will be several times that at summer temperatures. This not only has an important bearing upon the magnitude of the electrolysis trouble that may occur at different seasons, but also indicates that where practicable voltage surveys should not be made when extremely low temperatures prevail.

Interesting wireless telegraph statistics relating to the year ending December 31, 1912, have been given out by the Bureau of the Census. The figures presented show that while there was a net deficit in operation in 1907, a net income was the result of the business in 1912. The gross income increased $562,367, or 527 per cent, over 1907. A great part of this income was the rental of wireless apparatus for ship equipment. The expenses, including charges for depreciation in 1912 increased $504,091, or 314.4 per cent. The great decrease in assets—$22,581,700, or 68.5 per cent—is due to the disappearance of one large company in a merger of interests. The decrease was largely in the value placed on patent rights, good will, and contracts in 1907, and on treasury stock. The amount expended for construction and equipment increased $888,156, or 280 per cent over 1907, and the number of employes 782, or 444 per cent; the increase in salaries and wages being $311,835, or 381 per cent.

A NEW ELECTRIC SMELTING FURNACE.

The availability of large deposits of iron, copper and lead ores in the West within reach of sources of cheap hydroelectric power make the electric smelting of these ores a necessity of the near future. Many furnaces have been designed and much money spent in overcoming the difficulties of the electric reduction of ores. One of the simplest and most practical is that recently patented by Louvrier and Louis, its main advantage being its temperature regulation by means of an electrode switch instead of movable electrodes. It can be used at high voltages and in all sizes up to



Sectional Details Louvrier and Louis Electric Furnace.

40,000 h.p., which the inventors claim is sufficient to produce 500 to 550 tons of pig iron daily.

The general arrangement of the furnace is indicated in the drawing, which represents a polyphase furnace.

Fig. 1 is a vertical section along 3-3 of Fig. 3. Fig. 2 is another vertical section along 4-4 of Fig. 4. Fig. 3 is a horizontal section along 1-1 of Fig. 1. Fig. 4 is a horizontal section along 2-2 of Fig. 2.

The furnace proper consists of three principal parts—the shaft A, wherein the progressive heating of the ore takes place; the bosh B, which is the zone of reduction, and the crucible C, where the molten metal accumulates. The crucible and the reduction chambers are lined with very refractory and non-conducting material D. The bottom S of the furnace is conducting and is connected with one of the phases of the current. It is made from varying material to suit each particular case; for instance, for iron ore reduction it is made of a piece of cast iron, with some cooling arrangement.

A series of openings are horizontally disposed at various heights in the two opposite walls of the bosh. Through each of these openings passes a well-fitting electrode. These electrodes form two symmetric series, opposite to each other. Each of the series corresponds to a phase of the current and each electrode in the series can be connected with its corresponding phase by means of a switch.

In smaller furnaces each electrode takes up the whole width of the furnace; in larger furnaces two or three electrodes are arranged at the same horizontal height side by side, as shown in Fig. 4, so that the size of each electrode remains within reasonable limits.

The electrodes of each series are insulated electrically from the other series by the furnace wall, which is non-conducting. The electrodes are pushed through the openings into the furnace so that they touch the charge without being immersed in it. The small space between the furnace wall and the electrode is luted in order to avoid leakage of the gas formed inside the furnace.

The electric current passes through the charge between the two series of lateral electrodes and between these and the bottom electrode. The charge acts as resistor, and as all parts of the charge are traversed by the electric current, a practically uniform temperature is obtained.

Evidently the current passing through the charge and consequently the temperature in the furnace depend on the number of lateral electrodes that are connected to the circuit and on the relative position which they occupy.

The temperature is always easily regulated by a simple movement of the electrode switches. The electrodes themselves are, therefore, immovable or nearly so; all that is necessary is to push them in from time to time in order to compensate for their consumption. As air cannot enter the furnace and as no hot gases circulate around the electrodes, this consumption is relatively small and the compensation need only take place once or twice in a week.

The crucible C is provided with two tap holes, one, L, for the slag and the other, M, for the metal.

For operation with single-phase or continuous current the furnace is arranged in the same way. One possible arrangement is a conducting sole connected to one pole, and a series of lateral electrodes occupying two opposing walls of the furnace and all being connected to the other pole of the circuit. Another possible arrangement uses two lateral opposite series of electrodes connected to the two opposite poles of the circuit, without a conducting sole.

In the reduction of 50 per cent iron ores, for each ton of pig produced, the energy consumption should not exceed ¼ h.p. year and the electrode expense 8 cents.

But slight modifications are necessary to adapt it to smelting copper, lead or zinc ores. A 40,000 h.p. furnace, it is estimated, would handle 2000 to 2500 tons of 5 per cent copper ore daily with a consumption of from 0.06 to 0.03 h.p. year, according to the routine of the ore and its sulphur content. Electrodes would cost about 2 cents per ton of ore treated. The total estimated cost, including general expense and amortization amounts to $1.20 per ton of ore treated when the smelter produces its own energy from water power. Further details are given by Francis Louvrier in the Dec., 1913, issue of Metallurgical and Chemical Engineering from which the facts in this abstract were prepared.

MITIGATION OF ELECTROLYSIS.

Damage to pipes and other buried structures by stray currents from the electric railway at Springfield, Ohio, has been carefully studied by the U. S. Bureau of Standards. An insulated negative feeder system applied to the tracks is recommended as the primary means of mitigation after a full consideration of all systems available.

Surface insulation of pipes by paint, treated textiles or tarred paper, insulating joints in pipes, and pipe drainage systems by direct taps between pipes and rails or negative feeders to pipes were all exhaustively tested and found wanting.

Other proposed methods include (a) chemical protection, which contemplates surrounding the pipes with certain chemicals, such as lime, etc., which are known to have a tendency to inhibit corrosion under certain circumstances, (b) the use of cement coatings on the pipes, (c) cathodic protection, or protection of pipes by maintaining them negative to certain structures by means of battery, motor generator, etc., (d) favorable location of pipes with respect to rails, (e) the use of non-corrodable conducting coatings, and (f) what may be termed electric screens which are sheets of metal placed near to or surrounding a portion of the pipe and electrically connected thereto. It is not necessary to discuss these at length here, as such a discussion will be found in publications of the Bureau of Standards to be issued shortly and it need only be said that the investigations showed that none of these methods can be considered seriously in connection with the permanent mitigation of electrolysis.

A more logical and at the same time a more effective and economical procedure is to attack the source of the trouble by applying remedial measures to the railway system. A number of methods are available for this purpose, but the majority of these, viz, the "alternating current system," the "double trolley system," "three-wire system," "negative trolley," "periodic reversal of trolley polarity," and "uninsulated negative feeders to rails," considered solely as methods of electrolysis mitigation were either impracticable or else open to the objection that the expense and operating difficulties attending their application were rendered unnecessary, because of the fact that there are other adequate methods available for general application which are comparatively cheap to install and which introduce but slight complication into the operation of the system. These latter methods are the four types of insulated negative feeder systems; (a) boosters in separate feeders, (b) without boosters, (c) single booster system, (d) inverted booster system. It is possible by the proper application of any of these methods to reduce the potential gradients in the earth to almost any desired degree, and they can consequently be made very effective in relieving electrolysis troubles. In special cases, however, it may sometimes be better, where conditions are favorable, to combine one of these methods with either the insertion of a moderate number of insulating joints in pipes, or with the use of a very limited amount of pipe drainage, the insulated feeder system being applied to reduce potential gradients throughout the system to a very low value, and one or the other of the auxiliary systems used to practically eliminate any residual electrolysis that might still remain. An additional advantage that would result from the proposed installation grows out of the more uniform voltage available at the cars. The rail drop being reduced to a small fraction of its former value the variation of car voltage will be chiefly that due to the drop on the positive side, and hence the voltage regulation at the cars will be materially improved. This gives rise to much more satisfactory car lighting, a matter of considerable importance to the traveling public.

In Springfield the insulated feeder system without boosters offers the most economical effective solution of the problem. The plan has been worked out in detail in Technologic Paper No. 27, the size and location of each feeder being given, and the first cost of the installation and the economies resulting therefrom are carefully estimated. Conclusions drawn from these detailed calculations are that the economies resulting from this initial outlay make it, from the start, a dividend-paying investment, the saving being sufficient in itself to justify the investment quite apart from its effect in eliminating electrolysis troubles.

Statistics of ocean cable systems for the year 1912 have been given out by the Bureau of the Census. Statistics of merely holding companies and of Federal Governmental cables and the statistics of two foreign companies, the Deutsch Atlantische Telegraphengesellschaft and the Compagnie Francaise des Cables Telegraphiques, having cables landing in this country, are not included. The figures, as presented, show that during the semidecade 1907-1912, the number of operating companies remained the same. The increase in nautical miles of cable was 21,375 or 46.2 per cent. There was a slight decrease in number of cable messages reported, but the gain in amount of income received from telegraph traffic was $727,518, or 9.9 per cent. The net income, as reported, decreased $1,076,227, or 26.7 per cent, there having been an increase in cost of operation and maintenance amounting to $1,803,279, or 81.8 per cent. No charges for depreciation were reported in the expense account at either census. The increase in profit and loss surplus was $3,001,083, or 85.8 per cent. Reserves were increased very largely, but the total can not be shown separately, as it is practically that of one system. The amount of capital stock outstanding was $2,689,400, or 5.1 per cent, greater in 1912 than in 1907; the number of wage earners increased 449, or 37.2 per cent, and the salaries and wages, $251,931, or 27.5 per cent.

LETTER TO THE EDITOR.

January 27, 1914.

Referring to the article on Electric Stimulation of Plant Growth in your January 24 issue I find that my manuscript contained two errors. These errors came in the final writing and escaped my attention. In the data given with Fig. 3 the watts per cu. ft. should be 3 instead of .03 and the watt-hours per cu. ft. should be 100.8 instead of 10.08. This will be seen at once as the test shown in Fig. 3 falls almost exactly on the curve of Fig. 1 as to increase in size.

Very truly yours,

W. D. PEASLEE.

LIGHTING METHODS

METHOD IN HOME LIGHTING.

[Concluded.]

8. Kitchen, Pantry and Cellar.

If direct lighting is chosen for the kitchen it should be installed high up so that every corner of the room is properly lighted. The more efficient types of glassware may be used in this location, as illumination rather than appearance is the end sought. It is advisable to install a portable lamp at the range with a comparatively short extension (cord) and a wire guard. There are many such inexpensive portables on the market provided with a handle, and a hook for hanging by when not in use. The lamp should be all frosted. A bracket light should be provided over the drain board of the sink, care being taken to equip the lamp with glassware giving good diffusion.

Semi-indirect lighting in the kitchen offers a means for the use of a center ceiling outlet only, the portable and bracket lights being then not required.

The cost need not be prohibitive as an inexpensive adapter is on the market which permits the use of ordinary commercial types of reflectors inverted, for this purpose.

Taking into consideration the necessity for reducing shadows to a minimum so that they are not objectionable when cooking is being attended to or work done at the sink, heavy density "opal" reflectors, such as those made under the name of Pyro, or Pheno, are recommended for this purpose. These give a small direct component of light and hence fainter shadows. A higher intensity of general illumination must be provided than would be the case with the combined local and general illmination such as that suggested with the direct lighting system abovementioned.

The greater intensity in general illumination is suggested with semi-indirect lighting and the non-use of bracket lights recommended for the reason that these last are incongruous when this system of lighting is used. The object of semi-indirect lighting is to secure perfect diffusion of the light with an elimination also of glare. To install a bracket light is to defeat this purpose. Even should a very dense glassware be chosen, and inverted, it is always brilliant by contrast or throws a too brilliant light upon a part of the walls. These are usually, in a kitchen, light in color, and this emphasizes the annoying brightness just above the bracket fixture.

A wall plug with switch and pilot light should invariably be installed to provide for the use of an electric iron, now an indispensable time, labor, and worry-saving appliance which it should be possible to use readily in every home.

If the sink is in the pantry as is the case in some of the smaller homes, and the pantry is of sufficiently large size, a bracket light should be provided over the drain board of the sink and a ceiling fixture fitted with an opal diffusing globe. If the pantry is small, this last mentioned fixture will be sufficient. The first arrangement is recommended when direct lighting is used in the adjacent kitchen, the last is suitable for any system of kitchen lighting.

In the cellar or basement one or more lamps should be provided for the purpose of local illumination. Portables with wire guards, such as that described for the kitchen range, will be found indispensable.

One of the main causes for high lighting bills is the careless burning of lamps installed in places where they may be easily forgotten. The basement light is the chief offender. Left burning for a whole month, as is often the case when the family is away from home and this single light will run up an "unexplainable" bill of $2.50 or more.

It is advisable to insure against this possible loss by installing a switch with signal light in the hallway at the head of the basement stairs so that the basement light is thus shown to be burning if unintentionally left on.

Out of sight is then brought to mind.

9. Bedroom, Bathroom and Boudoir.

Colonial furniture in bedrooms is now quite commonly used but it is rarely the case that the lighting fixture is typical of the same period. This style is particularly mentioned as not only is the furniture pleasing and appropriate, but Colonial lighting fixtures with their upright unit are particularly suited to this service. As a matter of fact, a five or six arm electrolier with upright, totally frosted lamps of low wattage comes about as near perfect a lighting unit as could be desired. Practically any of the properly designed Colonial fixtures are effective and comparatively efficient.

Generally, bedroom lighting should be well diffused and clear lamps, even with pendant shades or reflectors are not permissible.

If direct lighting is decided upon the glassware should totally enclose the lamps. Latterly several beautiful and appropriate designs of this kind have been placed on the market. Wiring should be carefully laid out and the furniture arranged on the plan, for two dressing table bracket fixtures should be provided as well as a bracket lamp at the head of the bed.

Reading in bed has been rendered safe electrically and few wish to forego this indulgence.

Semi-indirect lighting with a small direct component of light, and indirect fixtures, are very satisfactory for bedroom lighting, but it is advisable even with indirect and semi-indirect installations, to provide an adjustable bracket lamp at the head of the bed, or a portable. In either case, an opaque reflector, also adjustable, should be used.

This will permit one to read in bed, or to light up temporarily during the night without annoyance to any other sleeper in the same room. Such a light is invaluable also for all night burning which is sometimes essential.

The switch for this lamp should be in an easily accessible place but on the wall, as to grope in the

dark to switch on a portable at the lamp is inconvenient to say the least, and oftentimes noisy.

The comfort of electrically lighting clothes closets cannot be calculated. This possibility is to most people perhaps better appreciated in anticipation, for all have experienced the inconvenience and difficulties encountered when endeavoring to locate things in closets not well lighted.

Whatever does away with the necessity for using matches for temporary lighting even if on rare occasions only, is a good investment.

Adjustable Portable With Opaque Diffuse Reflector.

The fear of lights left burning is easily overcome by the use of switches which automatically cut in the light when the door of the closet is opened and cut it out of use when the door is again closed.

Electric lights should be provided for all closets.

The boudoir lighting arrangements must of course be left to the lady of the house as to choice of fixtures and style of lighting, but the fundamental requirements are the same in this room as in the bedrooms. The special lighting provided depends entirely upon whether it is to be used as a work-room, a dressing room, or a happy combination of both.

In any event a baseboard receptacle conveniently placed will be found invaluable for the use of small electric appliances such as the luminous radiator, electric curling tongs and so on. A sewing machine lighting fixture might be connected to this outlet and will certainly be found a boon.

Bathroom lighting is best carried out by means of a semi-indirect lighting fixture as this room is not as a rule large and a comparatively small lamp will, with the light colored walls and ceiling, give a high intensity of illumination. The light is used for only a short space of time and economy of current consumption should not enter into consideration.

If direct lighting, which is here of necessity unsatisfactory, is nevertheless installed, bracket lights should be provided on either side the shaving mirror and these equipped with diffusing glassware.

10. Servant's Bedroom.

It often happens that this room has the disadvantage of being the last considered and as a consequence is usually equipped with a drop cord. The servant may in nearly every case be relied upon to purchase a long extension cord and this is not only unsightly and an inconvenience, but may prove dangerous and expensive.

If a drop cord is selected for this room it should be fitted with a pulley and counterweight and made of sufficient length to reach the different important points in the room such as the head of the bed, the bureau and so forth. At each of these points an inexpensive bracket should be provided to which the lighting unit may be quickly and securely attached.

On the other hand, a semi-indirect fixture composed of an opal reflector and an adapter, will prove inexpensive and most economical.

General Remarks.

In this article has been outlined the fundamental requirements of good lighting in the home. The different systems and the suggestions made, will be taken up in more detail in further articles.

The wiring plans and specifications are of great importance and will be considered in a special article which will cover not only the lighting installation but the wiring for all appliances which might be used. From such a complete specification may be abstracted the explanatory details to cover any particular installation.

But before this is done an article will be published on planning lighting installations. This will show the method of arriving at the size of lamp required and will give further aids for determining the system of lighting to be used.

Fixtures of all styles—direct, indirect, and semi-indirect have been but referred to in general. These will from time to time be dealt with in more detail, as also will the design of lighting glassware and its proper use.

This proper lighting of the home is of intense importance and will be dealt with from every possible angle. It should however be borne in mind that general directions while of great value fail in particular instances, especially where the decorative features have to be considered.

What is good for the goose is not always good for the gander. Equipment in one room beautiful and harmonious, will in another appear entirely out of place.

It is an excellent thing for the trade that habits and tastes differ. This urges improvements in design and application. The object of these articles is therefore not to show how the specialist in this line may be elminated, but rather to emphasize his importance to show how you may better appreciate his view-point and the necessity for close co-operation that a successful installation embodying the best method in home lighting may be assured.

SAFETY REGULATIONS FOR ELECTRIC POWER COMPANIES.

BY W. K. FREUDENBERGER.

(This paper was read by the author, who is Chief Engineer State Public Service Commission, Nevada, at the recent industrial safety conference held at Reno. Standard specifications are referred to and the requirements of the laws of Nevada governing safety regulations for electric power companies stated. The small number of accidents which have occurred in that State are also made a matter of record. The discussion of the paper is included.—The Editors.)

The above named subject was assigned to me for a paper to be presented at this meeting, with the explanation that it is for the purpose of securing uniform practice in the protection of high voltage electric lines, and, further, that it touch upon the Nevada laws on the subject.

Taking up the subject of uniform practice in the construction of electric lines, including all classes, from low voltage to extra high voltage, I unhesitatingly recommend the adoption of the specifications prepared by the National Electric Light Association, and published in their 1911 report.

In order to properly bring the subject before the meeting for discussion, some of the most important parts of those specifications are attached as an appendix.

Adverting to the Nevada laws on this subject, I find the following:

Laws of Nevada, Approved March 26, 1913.

All regular line wires for electric light or power service, shall be placed a distance of more than 16 in. from the center line of any pole, whether or not they are attached to same.

Line wires intended to carry more than 600 volts, shall be spaced 4 ft. or more in a vertical direction from line wires intended to carry less than 600 volts, but the distance between such wires may be only 32 in. in a horizontal direction if placed on the same crossarm.

Provided, however, that at all times a clearance of not less than 2 ft. in a vertical direction at point of crossing is maintained between wires carrying more than 600 volts, and wires carrying less than 600 volts.

All crossarms on which are lines carrying from 600 to 15,000 volts, shall be painted a bright yellow, or, on such crossarms shall be placed enameled iron signs, providing in white letters on a green background, the words "High Voltage," and these letters shall not be less than 3 in. in height, and said signs shall be securely fastened to the face and back of each crossarm.

All guy wires attached to poles carrying electric light or power wires, shall contain insulators at a distance of not less than 4 ft. nor more than 8 ft. (measured along the line of guy wire) from the upper end thereof, and not less than 8 ft. vertically above the ground from the lower end thereof, and provided further that whenever two or more guy wires are attached to same pole and same anchorage there shall be at least 1 ft. vertical space between the points of attachment. And further provided, that where guy is attached to a pole or structure of steel or other conducting material, which is thoroughly grounded, no insulation shall be required in any point in said guy.

All electric light and power wires which are run vertically on poles shall be wholly encased in conduit equal in durability and insulating efficiency to a wooden casing not less than 1½ in. thick.

Arc lamps and transformers shall not be placed on the same pole.

None of the provisions of the preceding sections shall be held to apply to direct current electric wires having the same polarity, except the spacing between pole and wires.

All span wires shall contain insulators at each end, insulators to be placed not less than 2 ft. nor more than 4 ft. from the ends.

The Public Service Commission of Nevada shall see that the provisions of this act are enforced.

Any violation of any of the provisions of this act shall be deemed a misdemeanor and shall be punishable upon conviction by a fine of not exceeding $500, or, by imprisonment in a county jail not exceeding six months, or by both such fine and imprisonment.

This act shall take effect six months from the date of its passage in so far as it relates to new work, and a period of five years shall be allowed in which to reconstruct all existing work and construction to comply with the provisions of this act.

The following law also applies to the larger electric companies operating in this state; those which have filed their acceptance of the terms of the provisions of the act approved March 2, 1901, Chapter 25, Laws of 1901, or which complied with the procedure authorized by Chapter 190 of the Laws of 1907. This law coming under Chapter 132, Laws of 1909.

Section 2. Such persons or corporations shall keep their plants, poles and wires, and necessary appurtenances in good repair, so as not to interfere with the passage of persons or vehicles or the safety of persons or property. Such poles shall be not less than 30 ft. in height, and the wires strung thereon shall be not less than 25 ft. above the ground, and such persons or corporations shall provide a competent electrician at the expense of such persons or corporations, to cut and repair such wires as are necessary for the removal of the buildings or other property through the streets of said counties, cities or towns with all due diligence.

Section 3. The appurtenances of said plant shall be of the most approved construction for the comfort and conveniences of the inhabitants of said counties, cities and towns of this state.

Although there have not been a large number of serious or fatal accidents on the high tension lines in this state, the number could be still further reduced by using greater care. I have gone over the accident reports made by the public utilities of this state for the last three years, which are on file with the Public Service Commission, and find that there were four accidents in 1911, three in 1912, and three in 1913, briefly described as follows:

Year 1911.

Lineman working on a corner pole guyed in only one direction. Pole broke off at ground line, resulting in a broken leg and sprained right arm.

Lineman repairing lightning arrester, exposed himself to the live side of same, and was severely burned.

Lineman was removing some unused wires from a pole. Pole had rotted off at ground line. When wires were removed the pole fell, resulting in a broken leg. Man was fastened to pole by a safety belt.

Lineman killed when telephone wire came in contact with high tension line. A line gang were stringing a pair of telephone wires on the poles of a live high tension line.

Year 1912.

Laborer was killed by touching an overhead high tension wire with an iron pipe. The wire was probably not more than 15 ft. from the the ground.

Three men in a surveying party using a 600 ft. steel tape, working beneath a high tension line, flipped the tape up against the wires and were all more or less severely burned.

Workman was killed by bringing a ladder into contact with a high tension line which was about twenty feet overhead.

Year 1913.

High wind blew down a pole carrying high tension line which came in contact with another line, resulting in a workman on the latter line having his hands severely burned.

Patrolman had his hands badly burned by a lightning stroke. He was standing on the ground repairing a dead transmission line wire, and had the line grounded with safety chains in the regulation manner.

Mining company built up a dump beneath a transmission line to such an extent that a workman in raising a track rail brought it in contact with the wires and received slight burns.

In addition to these reports I will refer to several fatal accidents which occurred in Nevada before 1911.

In 1904 a lineman was killed while repairing a dead line, which was on the same poles with a live line, the wire from which he received the fatal shock evidently having come in contact with the live wires. The manager of the company operating this line, states that since this accident no repair work has been done on this line until both circuits have been disconnected and grounded.

In a second case, occurring in 1909, a man was electrocuted by leaning against a corrugated iron building with one foot against a tram rail which extended into a tunnel. A 2000 volt wire, which crossed over this building came in contact with the roof. The sagging of the wire being caused by the breaking of a guy wire two poles distant from the building.

In a third case, a carpenter was killed when he turned a switch on a 110 volt circuit. It was suspected that the distributing line had come in contact with a 2000 volt line. Since that time all transformer neutrals on the system have been grounded.

A fourth case occurred in 1909. A lineman was electrocuted while tying in live wire lines carrying 4000 volts.

A fifth case occurred in 1909. A lineman was electrocuted by being grounded from a 4000 volt line to a guy wire which was not properly insulated. The line was supposed to be dead at the time, but due to an oversight of the entire repair gang one switch had not been opened.

A sixth case occurred the same year. A lineman was electrocuted when he climbed a tree and attempted to remove a loose limb from contact with a 2000 volt line.

A seventh case occurred in 1910. A lineman was electrocuted while working on a 220 volt line. A 2000 volt line became loose and dropped on a transformer, and in some manner the higher voltage was transferred to the line on which the man was working.

The Telluride Power Company, one of the pioneers in high tension transmission, writes as follows on this subject:

On the transmission lines where one would expect the greatest danger, we have had practically no serious accidents. We never work on a live high tension line, nor do we employ the construction now coming into such widespread use of having two 3-phase circuits on one structure. Before any repairs are made to any section of line, switches are opened at both ends. In addition, we have a rigid, switch-type, grounding and short circuiting device to prevent dynamic voltage being thrown on the line and to remove static charges. These grounding devices are arranged so as to lock shut and be under the absolute control of the men working on that particular section of line.

We do not install telephone wires on our high tension transmission structures. Our reasons are mainly to avoid operating difficulties rather than to obviate any danger there may be.

Our stations are so designed that operators cannot come in contact with any high tension parts in the ordinary pursuit of their duties. During the 15 years operation, several accidents have occurred, but they may all be attributed to occasional lapse of human vigilance in pursuit of a thorough knowledge of the danger. The operators are thoroughly cognizant of the danger when doing special work, and there seem to be no further measures toward the protection of human life than we have already taken.

In further reference to this subject I have for distribution a number of copies of the Safety Regulations for Public Utilities which were issued by the Public Service Commission. I also have single copies of safety rules issued by some of the large operating companies which anyone present may inspect.

In conclusion I will say that in my opinion the best way to secure safe construction and operation of high tension lines and apparatus is to employ none but competent and experienced men.

Discussion.

George A. Campbell, general manager of the Truckee River General Electric Company and the Reno Power, Light & Water Company opened the discussion. He dwelt principally on the work of safety inspectors sent out by the Stone & Webster interests and who had recently made very careful inspections of the plants in and near Reno. Although the management had expected a good report on the latest plant, a three-page report had been rendered by the inspector, recommending the installation of barriers and other safeguards. The other plants had been treated in the same way, an exhaustive report having been rendered on each. In addition, the inspector presented a report covering general accident dangers, in which were treated such matters as ladders, fences, railings, emery wheels, wiring parts, etc. Considerable space was given to housekeeping accident prevention and the necessity of using proper precautions with tools and implements. He said the operators had taken kindly to the safety first movement and he expected good results from it.

Fred A. Mechling, manager of the Nevada-California Power Company, spoke of the dangers of grounding motors in mine work. Their system comprises 350 miles of 50,000 volt and 50 miles of 6600 volt transmission line and, in addition, the lighting circuits. When a line is being worked on it is killed and grounded and as an extra precaution safety chains are placed. On all the 6600 volt lines linemen are required

to wear rubber gloves, insulated to 10,000 volts. All lighting transformers are grounded. As showing how the unexpected sometimes happens, he cited a recent case in which some boys had thrown a baling wire over the 6600 volt lines crossing with the arc circuit below. About a mile distant the arc and incandescent circuits had become crossed by a wire. As a result a customer in turning on a light in his basement received a severe shock and if he had not broken the lamp cord in endeavoring to release himself, the accident might have resulted in a fatality.

L. W. Crehore, electrical engineer, Fallon (Nev.), Municipal plant, continued the discussion and said in part:

Safety should be one of the first considerations of every power plant and distributing system. This applies in a more marked degree perhaps to those operated by municipalities than to others. Because disregarding the fundamental principal that no person or group of persons has a right to sacrifice human life or be responsible either directly or indirectly for damage to property or personal injury, and considering the subject from a purely commercial point of view, it is a fact that municipalities are in nearly all cases forced to pay larger sums to liquidate damage claims than are private corporations, resulting necessarily in high cost of service and in some instances increased taxation, to say nothing of censure brought upon public officials and through them upon the citizens themselves.

Early in 1912 the city of Fallon in this state, through its Mayor, George Sherman, and the city council, issued bonds to the amount of $15,000 for the purpose of constructing a municipal distributing system, entering into a contract with the U. S. R. S. for a power supply to be delivered at 2300 volts at a substation located near the city limits. The building of the system was commenced in the summer of the same year on force account and 5½ miles of line completed September 21, on which date service to customers commenced. During the construction of the system and later when operating, the mayor and council have acted in the nature of an advisory board, filling a position similar to that of a board of directors in a private corporation, and to them and their good judgment credit is due for making it possible to build the system in a substantial manner, with the best material obtainable, and labor at a fair wage, giving due consideration to safety at all times.

Mr. Crehore then gave a description of the methods of line construction and safety precautions adopted by the municipality.

F. O. Broile, superintendent Elko-Lamoille Power Company, contributed the following to the discussion: It is a well recognized fact that in most damage suits that are brought into courts, the injured party was injured, apparently by carelessness or neglect on his own part. When investigated it is generally found due to momentary forgetfulness. If the injured party had remembered at the particular moment that there was danger in a certain operation, he would not have done what he did. Call it what you will, when thoroughly examined, it is generally momentary forgetfulness. Some people are more careless than others; they take greater chances; they estimate that they can do things and carry them to a greater extreme than prudence would justify, and some day, the inevitable occurs. They do not, however, mean to get themselves injured; they think that there is no danger, or that they can escape the penalty of doing certain things. They have done these things several times before when everything was just right, but the unexpected occurs in some manner, the conditions are changed suddenly, and they cannot escape being injured or killed. This kind of danger, however, is probably less frequent than the other, that due to momentary forgetfulness. Employers think that, in any case, they ought not to be held financially responsible for the accident. I believe that a broader view of the matter should be taken, and we should realize that as long as human nature is what it is, we should make every endeavor to avoid injury, even going beyond the point legally demanded. Those who have had damage suits decided against them, should look upon the verdict, not as a charge of neglect or carelessness upon their part, but take the broader view, that it was an accident of the industry, and that the more humane method is for the industry to carry the burden rather than the individual, who almost invariably is less able to stand it. Our old law has not been entirely just, for the reason that if the corporation or employer was not financially able, a heavy verdict would mean his ruin, or the victim would not be able to be recompensed for his injury.

With the present industrial insurance that we have in this state, the burden is placed upon the industry as a whole, where it rightfully and justly belongs. With this idea in mind, it is our duty to study the experiences and ideas of others, as to the matters of safety, and try to get our apparatus into such shape that it is difficult for a man, who is careless, to get hurt, and also to eliminate that more serious danger, which is that due to momentary forgetfulness. It is impossible for us, of course, to get all apparatus absolutely safe, and the only thing we can do is to impress it upon the minds of the employes that it is expected of them to be careful, and bear in mind constantly, that certain apparatus is dangerous. With apparatus that is very dangerous, the back of a switchboard, for instance, which the writer mentions, because he is more familiar with electrical topics, special precaution should be taken. On small switchboards, it is not practicable to make them as safe as they would be in large plants, where the switches can be put in cells, and all other high voltage conductors well protected, so that it would be difficult to get at them. A switchboard should be fenced off, and at the back of it, there should be a sign, "Danger," "High Voltage," or something of the kind which will constantly impress upon the minds of the operators. This danger sign should be more frequently employed in places where persons have very little occasion to go, because that is a possible source of danger not often heeded. I believe that all wires that are lower than seven or eight feet carrying high voltage currents should be protected in every possible way from accidental contact. The practicability of doing this in all cases, is not well settled.

The writer has in mind one or two cases. In one case, he insulated some heavy bus bars carrying 2300 volts. An official of the company, who had had experience in another company, thought that this was bad practice, and condemned it strongly on the ground that in case of a short circuit, the arc would burn the insulation and cause more destruction of property than would otherwise occur. The writer held in that particular case, the possibility of trouble arising with an insulated bus bar, was greatly reduced; also that there was a source of danger which was of more importance than any destruction to the apparatus of the company, and that was, safety to the operators. The manager held that the operators would have to be careful. A few weeks afterwards, an accident occurred of an unusual nature. An operator was on a ladder, some little distance away; the ladder slipped, and he fell across the insulated bus bar. He escaped without even a scratch. No one will deny the fatal result, had the bar not been insulated. Sometime afterwards, lightning came in there, destroying portions of the switchboard. The arcing that resulted, showed its mark on the switchboard, but the insulated bus bar reduced the extent of the damage. Another source of danger is on oil break switches. At one plant, it was decided not to insulate the switch terminals. The writer, some time after the switches were installed, in examining the back of the board, stumbled, and but for his quick recognition of the danger of touching the terminals of the switch, would have come in contact with them, and as it was, saved himself only by a few inches, by catching the oil tank of the switch. The terminals of the switch were only a few inches apart, and some years afterward, something got between, I believe it was a bat, causing a short circuit, with considerable interruption in the service.

It is hard to insulate the terminals of a great many oil break switches that are now on the market. It is a defect which can be satisfactorily remedied by the manufacturer only. This ought to be impressed upon him as a possible source of danger. It would not be difficult to insulate terminals with a bushing or something of the kind. A bureau or committee for the interchange of experiences, and by calling the attention of the manufacturer to such serious defects that might exist in the apparatus, which is disclosed only by actual experiences, would probably meet with good results. Experience, after all, is the only true test as to whether certain apparatus be safe. A certain type of construction or apparatus is designed by competent and experienced engineers. It is something new in the line, and no pains are spared to insure safety. From an unexpected angle, a source of danger develops.

A bureau or committee, by recording the experiences, and investigating the accidents, would be of invaluable assistance to its members, calling their attention to dangers of a similar nature, that might already exist in their own system.

Working on high tension lines is always a source of well-recognized danger, especially where there are a number of power houses, substations and lines.

The following rules were gotten up for the Elko-Lamoille Power Company, where there are only two plants, a gas engine plant at the receiving end, and a water power plant at the other end, with one line only, connecting the two.

High Tension Line Operation.

The high tension line at all times must be handled as if alive. Great care must be used when turning on the current that no one is working on the line. When current is off line, and men are working on the line, a sign must be hung on the high tension switch both at the power house and at Elko, worded, "Men on line." Turn on current only on orders from ....." (A space is to be left for insertion of a card giving name of party to order current turned on. When orders are given to turn off the current, it must also be stated on whose order it will be turned on. No one's else order can be accepted, except in special cases where the attendant assures himself that the one ordering the current back is a responsible person, and that he has been authorized by the proper party. The power house attendant must assure himself thoroughly on this matter, regardless of who orders the current turned on.

Men on line must always telephone to the power house before touching the line. When informed that it is dead, they must then ground the line properly. The proper way to ground a line is to drive a steel peg about two feet long into the ground with grounding wire attached before going up the pole, then hooking the wire over the line. When connecting to line, hook it solid. Do not touch it to see if it arcs, as you might draw the arc against yourself.

The telephoning and grounding can be dispensed with under certain conditions, namely, if line is completely down and men are sent out in an auto and dropped off every few miles to patrol line. They must, however, have a written order from some responsible person saying that the current will be off. Said person will take down the names of the men authorized to work on the line, and until they are all accounted for, he cannot order the current turned back on the line. The only persons authorized to give orders as above are: G. B. McBride, F. O. Broili and C. A. Stephenson. In no case, however, are the men to be sent out to work on the lines without grounding one or both ends.

The instructions issued by the Public Service Commission of Nevada entitled, "Safety Regulations for Electric Utilities," are made a part of these rules, and all employes must read them carefully, especially paragraphs 6 to 27.

All employes must sign these rules, stating that they have read, and thoroughly understand them.

Joseph Bean, electrical superintendent U. S. Government power plant at Lahotan, Nev., stated that they had had a good deal of trouble on account of using 2300 volts on all the system. This had been finally eliminated by careful attention to grounding and the proper exercise of precautionary measures. On all the outdoor construction work such as on the steam shovels, etc., armored cable was used. Rules had been laid down for the handling of the 16 mile 33,000 volt transmission line to Fallon and in the station the switchboards were properly fenced off.

A. H. Babcock, electrical engineer of the Southern Pacific Company, in closing the discussion, called attention to the fact that there always was a divided responsibility in case of an accident. There always existed the necessity of every operator taking the proper precautions himself and in addition there was the responsibility of the foreman or man in charge of the work. He mentioned the excellent results that had been obtained from the practice of the Southern Pacific Company in holding open meetings to discern the causes and results of every accident of any consequence. When employes realize that they are apt to be called up before a public meeting to account for an accident they are much more apt to use greater caution in their work. Mr Babcock spoke of the recent visit of insurance inspectors to the company's power house in Oakland and although they had planned to spend three or four days going over the station and making recommendations, they found nothing to report on and complimented the company very highly on having covered the safety first work so thoroughly.

At the close of the discussion Prof. Scrugham spoke of the necessity of having a permanent committee of the power companies to discuss local conditions and standardize the practice on many of the questions that are continually rising. He spoke of the necessity of agreeing upon the proper voltage for mine locomotives as one question that is at present alive.

More than 14,000 prisms, to be a part of the illuminating scheme of the Panama-Pacific International Exposition, have reached San Francisco from the Austrian manufacturers and more shipments are expected soon. A total of 125,000 prisms will be used. These will be suspended from the domes and facades of buildings and when the colored rays of powerful searchlights play on them, they will scintillate like precious stones.

The use of electric signs of more or less display qualities is gaining in favor even in the city of Hong Kong, though so far, the extent of such use is limited and the variety of the signs employed comparatively modest. Several of the larger Chinese business establishments, notably the Chinese department stores facing on the water front and the large Chinese restaurants along the water front and in the parts of the city given over to such establishments, are displaying signs of some size and importance, generally in the shape of Chinese characters. Moving signs in the colony so far are confined to alternate shows of color, appearing and disappearing, and other more simple forms of mechanical signs. They represent a big advance over ordinary Chinese signs and advertising signs in this part of the Far East generally, but are in no sense representative of modern mechanical sign advertising. As a rule, Hongkong architecture lends itself fairly well to such displays, even with the limitations noted. Electrical energy is not unduly expensive and the general disposition in the port is toward the use of all such modern aids to business.

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CONTENTS

Financing Irrigation and Power Development..... 133
By John H. Lewis.

Effect of Forests on Runoff..... 135
By J. C. Stevens.

A New Electric Smelting Surface..... 138

The Resistance of the Soil..... 137

Interesting Wireless Telegraph Statistics..... 137

Mitigation of Electrolysis..... 139

Statistics of Ocean Cable Systems..... 139

Letter to the Editor..... 139

Method in Home Lighting..... 140

Safety Regulations for Electric Power Companies..... 142
By W. K. Freudenberger.

More Than 14,000 Prisms..... 145

The Use of Electric Signs..... 145

Editorial..... 146
Regarding Electric Lamps.
Safety First for Power Companies.
Selling Electric Service.

Personals..... 148

Meeting Notices..... 149

Industrial..... 150
High Tension Switching Equipment.
Unique Power Plant for Ford Motor Company.
Hydroelectric Development in Alasko.

Book Review..... 151

News Notes..... 152

Regarding Electric Lamps

The ultimate efficiency of electric lighting is not yet, neither its complete uses, nor the invention of the equipment by which the ultimate improvement will be made possible. During the carbon lamp age, popular lecturers would often point out the possibilities of increased efficiency of electric lighting, but no one at that time, even in the wildest divagations of fancy, deemed that changes in styles and efficiencies once commenced, would prove so rapid. It is practically impossible, except under business compulsion, for the average man to keep posted.

Changes often emphasize that "the stone rejected of the builders is become the head of the corner." At one time discarded as unsatisfactory, the better viewpoint made possible by invention along other lines, makes the same thing fundamental to further progress.

The basic principles of the carbon filament lamp were all to be found in the then forgotten experimental lamp of Starr who died during the same year in which Edison was born.

Many patented metal filament lamps were abandoned by those responsible for their invention upon the introduction of the carbon filament lamp which could be produced so much more cheaply, only to be again introduced on a quality basis to force the same carbon lamp off the market.

The possibilities are that the carbon filament lamp has not gone out, but that it will be resurrected in a more efficient form.

The use of nitrogen filled lamp bulbs is not altogether new, although it has resulted in such remarkable efficiencies in the light of a new purpose.

As far back as 1883 a patent was granted to Thos. A. Edison covering the introduction of nitrogen into electric lamp bulbs, although for the purpose of preventing the electric discharge between the positive and negative ends of the filament, and it had also been used for the prevention of oxidization of lamp filaments.

This in no way minimizes but rather adds to the credit of those inventors who are able to pierce the veil of limitation and determine actual use, and most complete.

The luminous efficiency of tungsten lamps, even of the so-termed "half-watt" or nitrogen filled lamp is comparatively low, but the limit of the temperature at which tungsten will satisfactorily operate is thought to be already reached.

A really white light from that source is impracticable. At a temperature resulting from operation at 0.20 watts per mean horizontal candle power the filament would last but a few seconds and there are other seemingly insurmountable obstacles. The production of white light would require twice that efficiency.

For this reason it is thought that the incandescent lamp will never entirely displace the various arc lights on an efficiency basis, as arc light efficiencies commence just where incandescent lamps are at their highest.

Dr. Louis Bell, at a recent meeting of the New England Section of the Illuminating Engineering So-

ciety mentioned, that in France an arc light had been produced having an efficiency of 0.175 watts per mean lower hemispherical candle power.

The day has passed when increased efficiencies are a matter of concern to those interested in the sale of energy. New lamps result in newer uses and increased efficiencies in greater current consumption.

It is not expected that the nitrogen filled lamps and the lamps of greater efficiencies will have any effect upon home lighting as they are only made in the larger sizes, but in commercial lighting they will permit the use of artistic effects heretofore excluded on account of high operating costs due to absorption.

The nitrogen filled lamp will undoubtedly find extensive use for locomotive headlights—a service for which it is particularly adapted and one in which it will permit a considerable reduction in operating costs. It will also give better results.

Although the possibility of further increased efficiencies exists it is not the part of wisdom to await them before adopting the best now available. A wise use of that we have is the best preparation for the advent of newer and better ways.

Safety First for Power Companies

Since their inception electric power companies have naturally been practicing the "safety first" idea urged by those laws electrical, which insist on compliance if electricity is to be servant, and not master. In their own interests, therefore, for the protection of the lives of employes, and to prevent waste, power companies have taken whatever precautions were known to be practicable and necessary.

Safety regulations for electric power companies have engaged the attention of national engineering associations and state legislatures.

At the recent Safety Conference held at Reno, Nevada, a paper was presented on this subject, the purpose being to secure uniform practice in the State of Nevada for safety in connection with the use of high voltage lines. Although dealing with Nevada laws on the subject, the paper and its discussion which appear in this issue will prove of intense interest to all electric power companies.

It was shown that only three deaths had resulted in the state of Nevada from contact with high voltage lines since, and including, the year 1911, and that of these, apparently one only was, a layman, and two were linemen. These deaths were due to unusual causes, and would in no way be considered as arguing against the use of high tension lines on public highways.

The hue and cry against the adoption of such high tension transmission, started by fear-mongers preying upon the public mind, in the interest of politics, is silenced by the witness of satisfactory and safe performance.

The vigilance of power companies and the use of protective devices has made these lines absolutely safe.

In high and higher voltage transmission on public highways, there is no need to place any limitation, for there is really nothing to be afraid of but fear.

Although the records show so few accidents in Nevada due to power transmission, the electric power companies in that state have, as a direct result of the conference, formed a commission for the purpose of effecting the adoption of uniform safety regulations throughout the state, for the benefit of the producer and consumer of electricity, and to promote the exchange of experiences in meeting the conditions of local practice.

Safety assurance is largely a matter of education, and the publication of those rules, which in the past have been known to a few, but obeyed, perhaps unconsciously, by all, should serve to still further reduce the possibility of accidents.

Selling Electric Service

There is a general awakening to the fact that the success of the salesman selling electric service is of economic interest to the whole electrical industry, for the more thorough he is, and the greater his all-round efficiency the greater the diversity and quantity of appliances sold, with the consequent increased business for all. His effort in selling electric service creates prospective customers for other commodities.

Although his position as stated is one of such far-reaching importance, the training of salesmen selling electric service has generally been neglected. A few large corporations have for years past carried out more or less comprehensive educational programs but as a rule the training given central station salesmen has been haphazard.

Any individual going onto a job as lineman, for example, but without tools or experience, could hardly be expected to prove a success. The experiment would be hazardous. Yet there are still a great number of men entering the central station field as salesmen, who have little or no conception of the comprehensive extent of the service they would sell. They are nevertheless of necessity sent out to close contracts and build business—that is to sell service—notwithstanding their lack of experience, and, because they do not possess the requisite specialized knowledge, without tools also. The whole industry suffers.

Poor sales-service is far-reaching in other directions, for it may result in a poor load factor with the consequent higher rates and possible dissatisfaction.

The past situation was perhaps due to the rapid growth of the industry. This necessitated the employment of innumerable untrained men. The perfecting of machinery and materials being of such vital importance the perfecting of men—more particularly, salesmen—was neglected. More attention is now being paid to this problem everywhere. It is of vital importance.

There is no necessity for questioning an oracle as to whether the central station business will continue. The air is charged with changes which will make progress even speedier along these lines and call for a more skilled selling.

This need on the part of the central station salesman should result in an aroused interest in electrical progress, for the future is bright with opportunity for the salesman selling electric service, but—he must be, aware.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

George A. Hughes, of the Hughes Electric Heating Company, is at Seattle.

Brewster Hall, of the Pass & Seymour Company, was in Seattle recently from San Francisco.

R. J. Kennedy of the American Electrical Heater Company, was at Seattle during the past week.

J. A. Devlin, field inspector, Western Union Telegraph Company, was at Fresno during the past week.

Jas. McCampbell has been appointed general manager of the Tehama Telephone Company, which has been recently re-organized.

Elmer Dover of the H. M. Byllesby Company, returned to Tacoma from the East on February 2d and is now on a visit to California.

Chas. N. Black, vice-president and general manager of the United Railroads, San Francisco, has been elected a director of the Petaluma & Santa Rosa Railroads.

Chas. C. Kutz, sales representative, Plume & Atwood Manufacturing Company, has just returned to San Francisco from a business trip made to Los Angeles and San Diego.

Hal Lauritzen, manager western division for Holophane Works of General Electric Company, has just returned to San Francisco from a rapid trip over his extensive sales territory.

L. F. Austin, of the Austin-McCain Company of Spokane, Washington, has been appointed Jovian Statesman for Spokane. **W. A. Davis,** city electrician, has been appointed alternate.

Miles F. Steel, salesman with Benjamin Electric Manufacturing Company, returned to San Francisco during the past week and has left for a business trip throughout the Pacific northwest.

J. D. Orr has been made district manager of the Idaho Railway, Light & Power Company, with headquarters at Nampa, and has been succeeded by **E. Vinning** as local manager at Caldwell, Idaho.

E. A. Wetmore, Jovian Statesman for Idaho, took advantage of the occasion of the three days convention of the Idaho Society of Engineers, held at Boise, Idaho, on February 5th, 6th and 7th, to attend in order to stimulate interest in Jovianism. **H. F. Holland, J. P. Sprunt** and **E. D. Bacon,** all of Salt Lake City, accompanied Statesman Wetmore, who had arranged for a rejuvenation to be held at the close of the convention.

Edward Watkins, of the Home Electric Company, Tacoma, has sold his business to **William S. Anderson,** formerly assistant manager of the Seattle branch, John A. Roebling Sons Company, **E. I. Salmson** and **J. R. McRae,** who has been employed by the Home Electric Company for the past year. Mr. Anderson will act as general manager and treasurer of the company. The contracting department of the concern will be discontinued and a reorganization perfected along exclusive jobbing lines.

W. R. Putman has been appointed commercial manager for the Utah Power & Light Company with headquarters at Salt Lake City. This position has remained unfilled since **C. Walter Jones** resigned from it a year ago, the work having been divided since that time between employes of the commercial department. Mr. Putman comes to Salt Lake from Rapid City, South Dakota, where for the past two years he has been manager and contract agent for the South Dakota Power Company, a syndicate company operating in several towns in the Black Hills.

J. Q. Brown, for many years in charge of the electrical and mechanical department of the San Francisco-Oakland Terminal Railways, will retire on March 1, and will be succeeded by **George St. Pierre,** at present master mechanic. **John Wells,** purchasing agent of the traction corporation, has been superseded by **P. Laduc. W. E. Hendley,** recently from the East, is organizing and will remain in charge of a new department to be known as the "coasting record department." Mr. St. Pierre's title will be superintendent of equipment and he will have charge only of the mechanical department.

Tasker L. Oddie, Governor of Nevada, is chairman of the new Nevada Safety Commission formed to perpetuate the work started by the Industrial Safety Conference held recently at Reno. The other members of the commission are: **V. L. Ricketts,** editor Reno Gazette & Goldfield News; **W. B. Alexander,** secretary Mine Operators' Association; **Geo. A. Bartlett,** attorney for Pacific Power Company; **H. A. Lemmon,** industrial agent, Truckee River General Electric Company; **W. E. Wallace,** legislative agent, Brotherhood of Railroad Trainmen; **Ed. Ryan,** state mine inspector; **J. J. Mullen,** secretary State Industrial Commission; and **J. L. Scrugham,** professor of electrical engineering, University of Nevada.

O. Arnspiger, city engineer, Harrisburg, Ore., was recently elected a member of the Oregon Society of Engineers, together with **D. L. Buckingham,** city engineer, Marshfield, Ore.; **H. C. Brandon,** instructor, Oregon Agricultural College, Corvallis, Ore.; **A. E. Hammond,** civil engineer, Chamber of Commerce, Portland; **L. E. Hinman,** assistant city electrical inspector, Medford, Ore.; **Arthur Kutsche,** building construction engineer, Portland, Ore.; **Edwin H. Kern,** civil engineer, Coquille, Ore.; **Ralph Modjeski,** consulting engineer, Corbett building Portland, Ore.; **Charles S. Noble,** city engineer, Oregon City, Ore.; **Benjamin Ostlind,** engineer and architect, 206 Irving Block, Marshfield, Ore.; **Robert Rea,** civil engineer, Chamber of Commerce, Portland, Ore., and **S. I. Stewart,** manager Lebonon Electric Light & Water Company, Lebonon, Ore.

MEETING NOTICES.

Los Angeles Section A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers will hold a "Throop Night" this month. The entire program will be provided by the students of Throop Institute of Technology. Prof. Sorenson promises an account of some interesting results of original investigations made by members of his class.

San Francisco Electrical Development and Jovian League.

The regular monthly business meeting was held at Tait's last Tuesday when arrangements were made to hold a joint meeting with the Alameda County Electrical Development League at the regular luncheon place on Tuesday, February 17th. All interested are requested to attend. Entertainment will be provided and several addresses have been arranged for.

Arrangements were also made to the end that a representative of the electrical interests be appointed on the board of fire commissioners when the next vacancy occurs. Other important business of interest to League members was also transacted.

Jovian Order at Portland.

The Jovian Order demonstrated their ability "to come back" by an attendance of over 100 at a noon-day luncheon at the Multnomah Hotel, on February 4th. Moving pictures were shown of the Panama Canal and the Los Angeles Aqueduct. The organization now owns a standard portable moving picture booth and will be able to show pictures at all their luncheons if they desire to do so. Mr. Burnett Goodwin of the Northwestern Electric Company acted as chairman. These luncheons will now be made a permanent affair and will take place twice a month, the next one being February 18th at the Multnomah Hotel.

These luncheons are not to be considered for members of the Jovian Order only, but are "an electrical event," and as "big doings" will take place at each, any "True Believer" in "Juice" is welcome.

Seattle Jovian League.

The Jovians met Friday, February 6th, in the Rathskellar Cafe when the after dinner talker was H. F. Tucker, who spent four years as designing engineer of the Panama Canal. During Mr. Tucker's talk it was brought out that electricity will be used extensively for domestic purposes in the canal zone owing to the scarcity of coal as fuel and the large capacity of the plant in the canal zone. Mr. Tucker also stated that in the lighting of the main locks 750 400-watt Mazda lamps will be used. These lamps will be embedded in the concrete walls and the filament of the lamp will be shielded from the pilot's eyes by a concrete hood. It is expected that the first commercial vessels will be allowed to pass through the entire canal on July 1st.

Correction.

In our issue of January 31st we quoted Mr. J. D. Ross, superintendent of the city light plant, as saying at the Seattle Jovian League meeting that the amount of current furnished by the city plant at Seattle was 4½ per cent. This should have been 34½ per cent, the lower figure having been published due to a typographical error.

Utah Electric Club.

The regular weekly luncheon of the Utah Electric Club was held at the Commercial Club Thursday, February 5th, at 12:30. The social and entertainment committee reported that they have arranged for a smoker to replace the regular weekly luncheon next week. Several good wrestling and boxing bouts are scheduled in addition to some of the best vaudeville by local and professional talent.

On this occasion the regular speaker of the day was Simon Bamberger, president of the Salt Lake & Ogden Railway Company—the Bamberger line. Mr. Bamberger went to work on the construction of the Union Pacific at Piedmont, and remained with the construction gangs until the junction of the Union Pacific and the Central Pacific was effected at Ogden. His reminiscences and personal experiences were extremely interesting.

Southern California Electrical Development and Jovian League

Ira J. Francis and associates, with the John A. Roebling's Sons Company, were hosts to the Jovian Electrical League of Southern California on Wednesday, February 4, 1914. Almost 200 members of the League assembled at the new plant of the company, at 216 South Alameda street, and partook of luncheon and inspected the plant and warehouse, where every modern convenience for handling the stock has been installed. Mr. Francis made a brief talk on the development of the Roebling interests in Los Angeles under his direction, starting out with an office which was aptly termed "nothing much but a Derby hat," until today, when they occupy the greater part of the flat iron block bounded by Alameda street, Stephenson avenue and Third street. The building is a substantial three-story structure of re-enforced concrete. The members were entertained by the Ad Club quartet, which rendered some fine vocal numbers.

Oregon Society of Engineers.

At the annual dinner of the Oregon Society of Engineers which took place on Monday evening, February 2, 1914, in the Blue Room of the Multnomah Hotel, Portland, Oregon, the following officers were elected: E. G. Hopson, vice-president; Henry Blood, treasurer (re-elected); Orrin E. Stanley, secretary (re-elected); and T M. Hurlburt, Russell Chase, J. P. Newell, directors. The members of the nominating committee named are as follows: S. B. Clark, B. C. Ball, C. A. Merriam, C. J. Hogue, Edwin A. Taylor, R. E. Kremers, E. I. Cantine, F. F. Henshaw..

About 70 covers were laid and quite a number of the members were accompanied by their wives. During the dinner several vocal solos were rendered for the members' and guests' entertainment. The speakers of the evening were: W. E. Coman, general manager of the Northwestern Electric Company, who discussed mainly the beneficial effects the operation of the Panama Canal will ultimately have upon the growth and prosperity of the North Pacific Coast. Franklin I. Griffith, president of the Portland Railway, Light & Power Company, made a plea for home products and an appeal for fair play on the part of the public toward the public utility corporations, about which, he said, there was no mystery, any more. W. H. Graves, president of the Oregon Society of Engineers, gave a masterful and intensely interesting address in which he brought out the reasons why membership in the Society should be sought; dwelt upon its activities and value and gave a comprehensive dessertation upon the duties of the engineer and his place in the social order. The address was enjoyed and appreciated by all those who had the pleasure of hearing it.

Addresses were made by P. L. Campbell, president of the University of Oregon, and W. V. Gates, owner of the water plant at Dallas, Oregon.

The secretary's report showed the society to be in a flourishing condition as regards membership and funds.

JOVIAN REJUVENATION AT LOS ANGELES.

Statesman J. N. Colkitt held a successful rejuvenation of the Jovian Order at Los Angeles on February 6th. Among the 29 candidates initiated were some of the most prominent electrical men of the city.

The rejuvenation was preceded by a dinner at the Union League Club. During the dinner several startling entertainment features were introduced which added greatly to the jollity of the occasion. Statesman Colkitt, after telling of the purposes of Jovianism, introduced A. E. Morphy as toastmaster. Geo. A. Damon spoke on the future of Los Angeles. Carl Heilbron told of the wonders of San Diego. Miles F. Steel, Statesman-at-large, answered the toastmaster's repartee in kind. A. H. Halloran outlined some of the plans of the Commercial Division and B. F. Pearson was spokesman for the candidates.

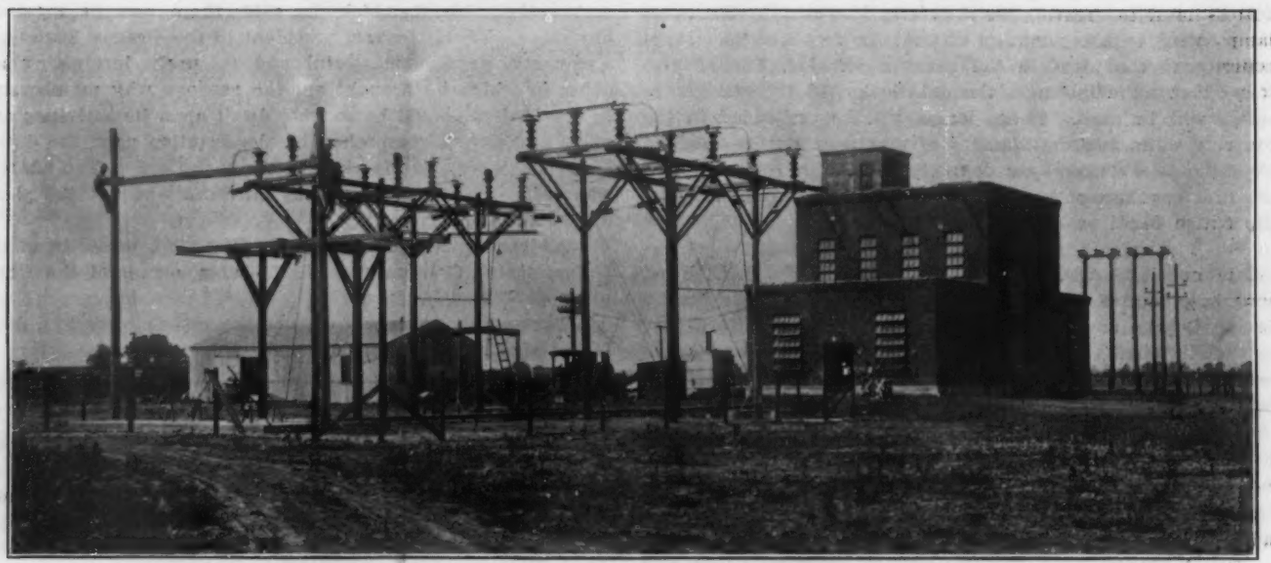
At the rejuvenation Statesman-at-large J. G. Pomeroy presided as Jupiter in his usual efficient manner. The rendition of the ritual was most excellent, as all the members of the permanent degree team had memorized their parts. The following officiated:

Jupiter, J. G. Pomeroy. Mars, A. L. Spring.
Neptune, J. H. Pieper. Apollo, C. C. Young.
Pluto, T. E. Burger. Avrenim, J. M. Morris.
Vulcan, L. E. Darrow. Mercury, D. H. Conover.
Hercules, H. L. Miller.
Imps: C. D. Lamoree, D. K. Barris, W. J. Bannon, B. C. Chase, W. R. Edwards, A. C. H. Jacobmeyer, S. T. Snow.

Those made rejuvenated beings are as follows:

Henry P. Clarke, Mechanical and Electrical Engineer, Hamburger's Department Store.
H. A. Hoagland, Hoagland, Hulse Electrical Company.
B. F. Pearson, General Superintendent, Southern California Edison Company.
C. H. Heilbron, President and General Manager, Southern Electrical Company, San Diego.
H. J. Alexander, Salesman, John A. Roebling Sons Company.
John E. Wilson, J. E. Wilson Electrical Company.
Parker C. Reid, Salesman, John A. Roebling Sons Company.
Clifton Peters, Clerk, Southern California Edison Company.
L. C. Fay, Westinghouse Electric & Manufacturing Co.
R. H. Sterling, Property Agent, Southern California Edison Company.
R. B. Rands, Sales Agent, U. S. Steel Products Company.
A. N. Johnson, President, Pacific Electrical Construction Company
G. B. Capps, Secretary, Faulkes-Gaylord Company.
J. M. Mullins, Manager, Crescent Electrical Company.
E. B. Clay, Owner, E. B. Clay.
H. C. Tilden, Power Salesman, Southern California Edison Company.
L. A. Hobbs, Salesman, Western Electric Company.
T. S. Halloran, Salesman, Hughson & Merton.
W. E. Oliver, Assistant District Agent, Southern California Edison Company.
W. L. Deimiling, District Agent Southern California Edison Company, Santa Ana.
A. B. Gentry, Greenwood Adv. Company.
J. E. Cope, Manager, Cope Electrical Company, Santa Ana.
Walter S. Sweet, Salesman, Illinois Electrical Company.
M. V. Simpson, Manufacturers' Agent.
W. B. Tavenner, Salesman Western Electric Company.
R. F. Foulkes, President and General Manager, Foulkes Electrical Company.
C. B. Hubbs, Pacific Light & Power Company.
Frank H. Smith, Clerk, Pacific Light & Power Company.
R. E. Ellis, Assistant Engineer M. of W., Pacific Electric Railway.

INDUSTRIAL



Hulls Substation, Showing Outdoor 100,000 Volt High Tension Disconnecting Switches in Foreground.

HIGH TENSION SWITCHING EQUIPMENT.

The pre-eminence of the Pacific Coast in hydroelectric development, with the consequent increase in the voltage of high tension transmission, in order to bring the power of the farthest site to the centers of useful distribution, has caused local industries to be born which could immediately produce the necessary equipment for these new and higher voltage lines.

Though created to meet an immediate local need the quality and importance of the product of these factories may be measured by the fact that the use of similar transmission systems throughout the country has often resulted in the adoption of this special equipment of western manufacture.

Some of the first difficulties encountered in the higher voltage transmission systems on the Pacific Coast were due to the lack of proper switching equipment. The design and building of switches locally has as a result, grown into a permanent and thriving industry.

The Pacific Electric Manufacturing Company, San Francisco was formed in 1906 for this purpose, and immediately commenced the manufacture of the Baum switch and other types, which have been developed from comparatively crude originals into standard products used throughout the United States.

It is a credit to California engineering that the lines of the Great Mississippi River Transmission system, from Keokuk to St. Louis, are equipped with 100,000 volt, 60,000 volt and 35,000 volt line switches manufactured by this company. The line switches of the Hulls substation of the Mississippi River Power Company, which are here illustrated, the

Shipment of 50 Pacific Electric 13,000 Volt Switches for Southern California Edison Company.

Pacific Electric 100,000 Volt Automatic Oil Switch—Port Marion Switching Station—Sierra & San Francisco Power Co.

100,000 volt switches of the Alabama Power Company, and of the Great Western Power Company, are also the product of this factory, as are the 100,000 volt oil switches of the Sierra & San Francisco Power Company's transmission line's switching stations and many of their substations.

The Pacific Electric Manufacturing Company's activities are by no means confined to the higher voltages, as the accompanying photograph of fifty 13,000 volt switches, forming one-eighth of the orders received from the Southern California Ediscn Company for the year 1913, will show. The Southern California Edison Company has adopted this type of switch exclusively for its 13,000 volt service, and has invited the Pacific Electric Manufacturing Company to refer to them, any prospective purchasers, or others who may be interested.

The following illustration is of part of a shipment of 60,000 volt oil switches to the Peninsular Power Company to

Michigan. This shipment and the other switches which complete the order, form the third order placed for these switches by this company, and associate companies in Michigan and Wisconsin.

To those who are familiar with the switches of seven or eight years ago, the many improvements and developments

Part of Shipment of 60,000 Volt Oil Switches for Peninsula Power Co., Michigan.

in the Pacific Electric Manufacturing switches will show an interesting development.

This firm was the first Pacific Coast factory engaged in the exclusive manufacture of oil and poletop switches and their product is used in over eighty per cent of Pacific Coast power transmission systems.

UNIQUE POWER PLANT FOR FORD MOTOR COMPANY.

The Ford Motor Company has placed contracts for a gas engine-electric power plant that will be not only one of the largest in the country but in many respects absolutely unique. The company has appropriated in the neighborhood of a million dollars for the project, which will put into effect plans Mr. Henry Ford has long had in mind for utilizing the waste heat of the ordinary producer gas engine.

Four 6000 h.p. Hamilton-Gray gas engines of novel design will drive the same number of Crocker-Wheeler 3750 kw., 250 volt, 80 r.p.m. engine type direct current generators These will be the largest capacities on record for generators of this type. A plan view of each engine will be similar to a cross compound steam engine, with two cylinders in tandem on each side. One pair of cylinders will be operated by producer gas and the other by steam. The steam will be generated from the water used in the water jacket of the gas engine, further heated by the exhaust gases and by waste heat from the producer gas plant. This water or steam will be used as the feed water for the boiler which supplies the steam engine cylinders. A heavy fly wheel will equalize the characteristics of the gas and steam driven elements of the engine. Each of the generators will have a normal rating of 3750 kw.

These generators are designed for much higher efficiency than ordinarily found in commercial practice. Full load efficiencies will be not less than 94½ per cent. By these means and by the utilization of energy usually lost in waste heat, it is expected to make the new Ford power plant the most economical in the country in respect to cost of production per kilowatt hour.

The armatures will be of split construction which is necessitated by clearance requirements through tunnels and bridges in shipment from Ampere to Detroit, and the generators will be finally assembled at the Ford Plant.

HYDROELECTRIC DEVELOPMENT IN ALASKA.

During the past year the Westinghouse Electric & Manufacturing Company has undertaken a number of contracts for hydroelectric development in Alaska that will do much to improve mining conditions in that territory.

The most important of these is the new generating unit for the Alaska Treadwell Gold Mining Company to be installed in the Nugget Creek Development. This unit will consist of a 2350 k.v.a. waterwheel generator driven by a Pelton water wheel running at 300 revolutions per minute. This unit will give the mining company about 3000 additional h.p. A 50 kw. motor generator exciter set with special shaft so that the unit may be water wheel driven when desired is also included.

A contract has also been recently closed for a 300 k.v.a. water wheel generator to be installed by the Chicagoff Mining Company, one of the Guggenheim interests operating near Sitka. This generator will be used to supplement the mining company's present installation which consists of 127½ kw. With the generator in question there were also ordered the necessary step-up and step-down transformers for transmitting the energy at high voltage from the power plant to the mines.

During the summer the Kennecott Mines Company, operating one of the highest grade copper mines in the world, located in the Copper River district, purchased a 200 k.v.a. water wheel generator, together with all the necessary switchboard and accessories. This water power plant will supplement a steam driven power plant now being operated by the mining company and containing one 400 k.v.a. generator and one 50 kw. generator.

A considerable number of electric motors for mining and milling operations were purchased with the above generators.

In addition to the above, the Alaska Juneau Gold Mining Company of Juneau, Alaska, recently purchased from the Westinghouse Electric & Manufacturing Company a 1012 k.v.a. water wheel generator to be driven by a Pelton wheel, the energy from which will be used to supplement that of a 937 k.v.a. steam turbine.

BOOK REVIEWS.

The Lighting Book. By F. Laurent Godinez; 109 pp.; size, 6 in. by 9½ in.; profusely illustrated from photographs; cloth bound. Published by McBride, Nast & Company, New York, and for sale by The Technical Book Shop, Rialto Bldg., San Francisco. Price, $1.25.

Written for the layman, this book, with but a little additional care, could have been made still more valuable to the architect, fixture dealer and practicing illuminating engineer. As it is, The Lighting Book contains much interesting information to all, on the subject of home lighting. Unfortunately, the author has a grouch, and his spleen is apparent in page after page which he thereby spoils. Masquerading in an entirely unsuited skin, he throws himself in front of the juggernaut car of a necessary commercial efficiency in a futile attempt to halt its progress. Furthermore, he sets up the puppet of an "illuminating engineer"—an early conception and disillusioned—and pelts it with the pellets of a contemptuous phraseology. "When you call a man a bad name," says Elbert Hubbard, "you are that bad thing." Mr. Godinez should forget the old and draw for the reader a pen picture of the now, and of his present self. So would the reader, layman and other, obtain a better, broader, brighter and more just conception of the profession of illuminating engineering which, together with the efforts of the much abused manufacturers of illuminating glassware, has contributed so vastly to the use of better lighting methods not only in the home, but in general. Even at that, the book is well worth studying, only—keep your myotic eye on the paragraphs with the grouch.

NEWS NOTES

INCORPORATIONS.

RICHLAND, WASH.—The Richland Telephone Company, $5000. Incorporated by E. E. Floyd, J. R. Gardner, Wm. Read and others.

CENTRALIA, WASH.—The South Hanaford Farmers Telephone Company. The incorporators are I. M. Pollack, F. R. Lobdell and others.

SEQUIU, WASH.—The Sequiu Mutual Telephone Company, $5000, by E. Roberts, Lou Goldsmith and P. A. McNamara, incorporators.

FINANCIAL.

PORTLAND, ORE.—The Pacific Light & Power Company, owner of many gas, electric light and power plants in the northwest, has filed a mortgage for $30,000,000 given to the United States Mortgage & Trust Company of New York City. This covers the company's properties in the northwest.

BOISE, IDAHO.—At auction $215,000 Idaho Railway, Light & Power Company first and refunding mortgage 5 per cent bonds and $388.26 scrip, 2454 shares Idaho Railway, Light & Power Company common voting trust certificates and $93.98 scrip, 572 shares of Idaho Railway, Light & Power Company preferred voting trust certificates and $58.19 scrip, $471.06 Boise, Payette River Electric Power Company 6 per cent bond scrip and $1000 Idaho, Oregon Light & Power Company first refunding 6 per cent bonds certificates of deposit and $721.80 scrip sold for $110,000 the entire lots. Idaho Railway, Light & Power Company organized in 1912 to acquire electric railway and lighting and power properties in Idaho, was placed in the hands of receivers in December. The company controlled the Boise & Interurban Railway, the Boise Railroad Ltd., Boise Valley Railway, the Caldwell Power Company, the Dewey Electric Light & Power Company and the Swan River Power Company. It also controlled the Idaho-Oregon Light & Power Company, which was placed in receivership in November and is now in process of reorganization.

ILLUMINATION.

SAN FERNANDO, CAL.—John T. Wilson has completed arrangements to rebuild his entire electric light system, same to be made up-to-date in every way.

McMINNVILLE, ORE.—The light and water commission has favorably passed on the application of the petitioners for electric service in the Fairview neighborhood.

SANTA ROSA, CAL.—At the last meeting of the Sonoma county trustees Fred Bulotti and R. E. Murphy applied for permission to use certain streets for conducting gas pipes.

ROSWELL, N. M.—A proposition for removal of the poles and wires of the telephone and electric light companies in the paved districts is under consideration by the city council.

WINNEMUCCA, NEV.—The board of commissioners on March 2d will hear the application of J. B. Fayant for a franchise to construct and operate electric light and power lines in the town of Golconda.

MARTINEZ, CAL.—A gas supply for Martinez is assured by Waldo Coleman, who applied to the city trustees for a franchise for the extension of his distributing mains under the public streets and alleys to all parts of the municipal domains.

MOAB, UTAH.—A petition for a franchise to erect and maintain an electric lighting system within this city was presented to the town board at its meeting last week by C. A. Hammond. The petition was laid over for one week for consideration.

RIVERSIDE, CAL.—Plans for a lighting system on Seventh street have been revived and have been approved by the public utilities board, and are now in the hands of the public utilities committee for investigation and report. The plans call for ornamental 3-light standards from Rubidoux to Santa Fe depot.

CHILLIWACK, B. C.—The town has entered into a ten-year contract with the British Columbia Electric Railway Company, light and power department, who will install 100 candle power tungsten lamps on the streets and maintain them for $18 a year up to one a. m. each night and for $27 per year if an all night service is desired.

TONOPAH, NEV.—The State Public Service Commission has reduced electric light and power rates in Southern Nevada from 5 to 50 per cent and the meter deposit cut from $10 to $5, effective March 5th. The domestic rate has been 18c per kw.-hr. The lines are owned by the Nevada-California Power Company, with headquarters on Bishop Creek, Cal.

BLACKFOOT, IDAHO.—The city council of Blackfoot is seeking a suitable site for a municipal lighting and power plant. One site on the Blackfoot River has been favorably reported. Offers have been made by power companies at Ashton and Idaho Falls to furnish current for power and light, but the council is desirous of installing a plant to be owned by the city.

CARLSBAD, N. M.—The Arkansas River Bed Oil & Gas Company of Cushing, Oklahoma, has applied to the city trustees of Carlsbad for a franchise for furnishing the town with gas for domestic, lighting and manufacturing purposes. The company agrees to pipe gas from wells in Oklahoma oil fields across the state of Texas and to have gas in Carlsbad in fifteen months. The council has the matter under advisement.

LOS ANGELES, CAL.—All the old directors and officers of the Los Angeles Gas & Electric Company were re-elected at the annual meeting of this company. The directors are W. B. Cline, Wm. M. Van Dyke, Wm. Baurhyte, C. P. Houghton, C. S. Vance, C. O. G. Miller, and A. Schilling. Following their election by the stockholders, the directors met and chose the following officers for the company: W. B. Cline, president; Wm. Baurhyte, C. P. Hougton and C. S. Vance, vice-presidents; R. M. Adams, secretary and treasurer; T. P. McCrea, assistant secretary and Horace Cline, assistant treasurer.

POINT GREY, B. C.—Messrs. DuCane, Dutcher & Company, consulting engineers, Vancouver, have prepared a preliminary report for the municipality of Point Grey, relative to the establishment of a municipal power plant and distribution system in that district at a cost of approximately $240,000, this expenditure to be spread oyer a two year period. The report favors provision being made for a plant designed to act as a reserve and substation for hydroelectric power, and recommends accommodation for a Diesel oil engine and a steam turbine plant with oil fuel boilers, the oil engines to be utilized for lighter loads. The distribution system proposed provides for the erection of pole lines in the outlying parts of the municipality and an underground system in the Shaughnessy Heights district. It is understood that the recommendations of the engineers will be brought up for discussion at an early meeting of the Point Grey council—probably early in February.

TRANSMISSION.

BANNING, CAL.—The Southern Sierras Power Company is conducting a transmission line from Banning to El Centro and expects to have same in operation within sixty days.

SAN FRANCISCO, CAL.—The city attorney has advised the supervisors that it will be proper to grant the Sierra & San Francisco Power Company a permit to lay underground pipes, wires and conduits in certain streets embraced within the Exposition grounds, on which the company now has the right to maintain overhead poles and wires.

LOS ANGELES, CAL.—The power companies have received the draft of the tentative agreement to be made with the city, providing for the lease and ultimate purchase of the distributing systems. The companies have been given until February 16th, to accept or reject the contract, which provides for complete control and operation by the city.

SEATTLE, WASH.—The county commissioners have granted to the city of Seattle a franchise covering the furnishing of light and power in the south district, operative for fifty years. The district is the same as that recently awarded to the Puget Sound Traction, Light & Power Company, and will be occupied jointly under a common user clause in the franchises. The city will be required to pay one-half the cost of installation of the pole line. In addition to the fifty additions, eleven county roads and five streets in the south district, the city and the traction company will jointly occupy the Lake Forest Park district, north of the city.

PORTLAND, ORE.—The Northwestern Electric Company has requested the city council to declare void the $100,000 bond given on the understanding with the city that when $350,000 had been expended the bond could be withdrawn. The ordinance granting the company its franchise was passed September 25th and the company put up its bond shortly afterward. According to a communication received from W. E. Coman, vice-president and general manager of the company, a total of $435,000 has been expended, $236,091 for the plant in the Pittock block, $71,957 for the Albina substation and $145,235 for the overhead and underground system.

BOISE, IDAHO.—The Idaho Public Utilities Commission is investigating the application of the Idaho Power & Light Company to enter the southeastern part of the state in competition with the Great Shoshone & Twin Falls Water Power Company in the Twin Falls district and the Southern Idaho Power Company in the Pocatello district. These two latter companies are controlled by the Kuhn interests, and have been supplying the electric light and power service of this rapidly growing territory. The Idaho Power & Light Company is controlled by Mr. L. L. Nunn. They have recently erected a plant on the Malad River and are seeking to enter the territory of the older companies, who are arguing in defense, that the territories served by them are supplied with sufficient electrical energy, and that if more is needed they are in a position to supply it.

EUREKA, UTAH.—Electricity is gaining in favor with the mining operators of the Tintic Mining District, and it is expected that during 1914 a number of companies will electrify their hoisting plants. The Eureka Reporter publishes figures submitted at the last meeting of the Victoria Mining Company, which shows that the electrification of the plant at their mine resulted in a saving of approximately $4500 per year. According to the statement for the year 1912, when the Victoria mine was operating a steam hoisting plant, the sum of $6589.56 was paid out for coal, and the expense attached to delivering it at the property; and for 1913 the company's expense for electricity was but a trifle in excess of $2000. This remarkable showing for the electrically operated hoisting plant has stimulated an interest in the electric proposition, and many of the other mines are investigating the advisability of changing from steam to electric power, including the Eagle and Blue Bell, Chief Consolidated and Grand Central.

REDDING, CAL.—A case that has been in the superior court for six years was settled when Judge Barber entered judgment by stipulation of all the parties concerned. The judgment is in the nature of a compromise. Parties to the suit are the Shasta Power Company, which has since been absorbed by the Northern California Power Company. The long list of defendants includes nearly every farmer living on Hat Creek in the eastern part of the county. The suit involved the right to use the waters of Hat Creek and Lost Creek. When the Shasta Power Company was organized it laid claim to 700 inches of water in Hat Creek and Lost Creek and dug a ditch conveying the water to its power plant on Snow Creek. Thos. B. Walker and others interested in farming land on Hat Creek, sued the company for damages and asked for an order restraining the company for diverting the water. The judgment now rendered allows the Shasta Power Company, or its successor, the Northern California Power Company, to divert the water only from the 15th day of September to the first day of the following May. From May 1 to September 15, or during the irrigation season, the farmers are to have the water exclusively. The company is enjoined from taking any water at any time from East Hat Creek. The farmers release all claims for damages.

TRANSPORTATION.

MILL VALLEY, CAL.—An ordinance has been passed granting to the Marin County Electric Railways a street railroad franchise along certain streets in this town.

BREMERTON, WASH.—An urban and interurban railway franchise from here to Hood Canal points has been granted to Gustav F. Rust, 834 Henry building, Seattle, subject to ratification by the voters.

PORTLAND, ORE.—The Portland & Oregon City Railway, unable to build its proposed line on East Seventeenth street, because of the referendum which recently was invoked on its franchise, has applied to the council for a new franchise over an entirely different route. It will be about two months before this application can be considered.

PORTLAND, ORE.—Extension of the United Railways to Banks is now receiving the serious consideration of L. C. Gilman, president of the road. The terminal of the road is Wilkesboro, about a mile from Banks. The right of way over most of the distance was secured four years ago with the understanding that the road was to be extended.

STOCKTON, CAL.—Subscription lists to secure the extension of the El Dorado street car line to Castle street, thence west to Tuxedo Park, are being circulated. It will cost something like $250,000 to build this extension. Of that amount the Stockton Electric Railway Company is asking those whose holdings will be enhanced by the extension to provide $100,000.

SALT LAKE CITY, UTAH.—Permission has been granted by the city commission to the Salt Lake Terminal Company to erect a temporary structure at the intersection of First West and Third South streets to be used temporarily as a depot by the Orem electric line, pending the completion of the Union interurban station which is contemplated by the Orem and Bamberger lines.

PETALUMA, CAL.—Directors of the Petaluma & Santa Rosa Railroad, at the annual meeting last week, discussed plans for an extension of the system north from Santa Rosa. The first section to be built would be between Santa Rosa and Healdsburg, but there is contemplated construction of additional trackage aggregating 50 miles. "Whether or not this extension will be made is to a large extent dependent upon the attitude of the people whose interests it is to serve," said Secretary McMurray. "If we receive the proper encouragement the improvements will be made without delay." The officers were all re-elected.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page opposite

A-1 American Ever-Ready Co.....
Los Angeles; 755 Folsom Street, San Francisco; Seattle.

B-1 Benjamin Electric Manufacturing Co.....
Rialto Building, San Francisco.

B-2 Berkeley Electric Cooker Co.....
1932 Center Street, Berkeley.

B-3 Blake Signal and Manufacturing Co..... 14
680 Howard Street, San Francisco.

B-5 Bridgeport Brass Co..... 3
(See Pierson, Roeding & Co.)

C-1 Century Electric Co..... 3
614 So. Grand Ave., Los Angeles; Salt Lake City; 56 Natoma Street, San Francisco; Seattle; Spokane.

C-2 Crocker-Wheeler Co.....11
Title Insurance Bldg., Los Angeles; Salt Lake City; First National Bank Bldg., San Francisco; Seattle.

C-3 Cutler-Hammer Manufacturing Co.....
579 Howard Street, San Francisco.

D-1 D. & W. Fuse Co.....
(All Jobbers.)

D-2 Dearborn Drug and Chemical Works 11
355 East Second Street, Los Angeles; 301 Front Street, San Francisco.

E-1 Edison Lamp Works of General Electric Co.....
(See General Electric Company.)

E-2 Edison Storage Battery Supply Co.....11
441 Golden Gate Avenue, San Francisco.

E-3 Electric Agencies Co.....
247 Minna Street, San Francisco.

E-4 Electric Storage Battery Co.....
Pacific Electric Building, Los Angeles; Spalding Building, Portland; 118 New Montgomery Street, San Francisco; Colman Building, Seattle; Pacific Building, Vancouver.

F-1 Fairbanks, Morse & Co.....
Los Angeles; Portland; 651 Mission Street, San Francisco; Seattle; Spokane.

F-2 Fort Wayne Electric Works of G. E. Co.....
Rialto Building, San Francisco; Colman Building, Seattle.

G-1 General Electric Co..... 17-18-19
124 W. Fourth Street, Los Angeles; Worcester Building, Portland; Rialto Building, San Francisco; Colman Building, Seattle; Paulsen Building, Spokane.

H-1 Habirshaw Wire Co.....
(See Western Electric Company.)

H-2 Hemingray Glass Co.....11
330 So. L. A. Street, Los Angeles; 345 Oak Street, Portland; 807 Mission Street, San Francisco.

H-3 Hoagland-Hulse Electric Co.....
1707 Naud Street, Los Angeles.

H-4 Hunt, Mirk & Co.....
141 Second Street, San Francisco.

I-1 Indiana Rubber and Insulated Wire Co.....14
807 Mission Street, San Francisco.

K-1 Kellogg Switchboard and Supply Co.....
Aronson Building, San Francisco.

K-2 Keystone Boiler Works.....
201 Folsom Street, San Francisco

K-3 Klein & Sons, Mathias.....20
579 Howard Street, San Francisco.

K-4 K-P-F Electric Co.....
37 Stevenson Street, San Francisco.

L-1 Leahy Manufacturing Co.....
Eighth and Alameda Streets, Los Angeles.

L-2 Locke Insulator Manufacturing Co.....20
(See Pierson, Roeding & Co.)

M-1 Mannesmannrohren-Werke .....
Rialto Building, San Francisco.

M-2 McGlauflin Manufacturing Co.....
Sunnyvale.

M-3 Moore & Co., Charles C..... 5
Van Nuys Building, Los Angeles; Spalding Building, Portland; Kearns Building, Salt Lake City; 40 First Street, San Francisco; Mutual Life Building, Seattle; Santa Rita Hotel Building, Tucson.

N-1 Nason & Co., R. N.....
151 Potrero Avenue, San Francisco.

N-2 National Conduit & Cable Co., The.....
Trust and Savings Building, Los Angeles; Rialto Building, San Francisco.

N-3 National Lamp Works of G. E. Co. 15
(All Jobbers.)

N-4 New York Insulated Wire Co.....11
629 Howard Street, San Francisco.

N-5 Norris Co., L. A. .....
Monadnock Building, San Francisco.

O-1 Okonite Co. 20
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co.....
80 Tehama Street, San Francisco.

P-2 Pacific States Electric Co..... 2
526 So. L. A. Street, Los Angeles; 90 Seventh Street, Portland; 526 Thirteenth Street, Oakland; 575 Mission Street, San Francisco; 307 First Ave., So., Seattle.

P-3 Parker Boiler Co.....
201 Folsom Street, San Francisco.

P-4 Pelton Water Wheel Co.....11
2219 Harrison Street, San Francisco.

P-5 Pierson, Roeding & Co..... .. 3-20
Pacific Electric Building, Los Angeles; Spalding Building, Portland; Rialto Building, San Francisco; Colman Building, Seattle; Pacific Building, Vancouver.

P-7 Pittsburg Piping & Equipment Co.....20
Monadnock Building, San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The.....11
211 J Street, Sacramento; 356 Market Street, San Francisco.

S-2 Simonds Machinery Co.....
12 Natoma Street, San Francisco.

S-3 Simplex Electric Heating Co.....12
612 Howard Street, San Francisco.

S-4 Southern Pacific Co..... 14-16
Flood Building, San Francisco.

S-5 Sprague Electric Works of G. E. Co.....14
Rialto Building, San Francisco; Colman Building, Seattle.

S-6 Standard Underground Cable Co..... 20
Union Trust Building, Los Angeles; First National Bank Building, San Francisco.

S-7 Staples & Pfeiffer.....
102 Steuart Street, San Francisco.

T-1 Thomas & Co., R.....
(See Western Electric Co.)

V-1 Van Emon Elevator Co.....
56 Natoma Street, San Francisco.

W-1 Wagner Electric Manufacturing Co.....11
Rialto Building, San Francisco.

W-2 Western Electric Co.....
119 East Seventh Street, Los Angeles; 507 Sixteenth Street, Oakland; 680 Folsom Street, San Francisco; 1518 First Avenue, So., Seattle.

W-3 Westinghouse-Church-Kerr Co.....
Pacific Electric Building, Los Angeles; Pacific Building, San Francisco.

W-4 Westinghouse Electric and Manufacturing Co..... 4-6
Lewisohn Building, Butte; Van Nuys Building, Los Angeles; Couch Building, Portland; 212 So. W. Temple, Salt Lake City; 165 Second Street, San Francisco; Central Building, Seattle; Paulsen Building, Spokane.

W-5 Westinghouse Machine Co.....
141 Second Street, San Francisco.

W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric and Manufacturing Co.)

W-7 Weston Electrical Instrument Co..... 3
682 Mission Street, San Francisco.

W-8 Western Pipe & Steel Co.....
444 Market Street, San Francisco; 1758 North Broadway, Los Angeles.